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SORBENT MATERIALS FOR CLEANUP OF HAZARDOUS SPILLS

by

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This report reviews the state-of-the-art of sorbent materials for cleanup of hazardous liquid spills. The pertinent characteristics of 90 hazardous liquids and a matrix is provided to indicate the tested and anticipated compatibilities between the liquids and sorbents. Some conclusions are drawn about the state-of-the-art and the suitability of various sorbent types. A comprehensive testing program is recommended.

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FOREWORD

The U.S. Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimonies to the deterioration of our natural environment. The complexity of that environment and the interplay of its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution; it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems to prevent, treat, and manage wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, to preserve and treat public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research and provides a most vital communications link between the researcher and the user community.

The state-of-the-art of sorbent materials for cleaning hazardous liquid spills is reviewed in this report. Information on the characteristics of 90 hazardous liquids and 28 sorbent materials is summarized, and recommendations on the use of the sorbent materials to clean up hazardous liquid spills are provided.

Francis T. Mayo, Director
Municipal Environmental Research
Laboratory

ABSTRACT

This report reviews the state-of-the-art of sorbent materials for cleanup of hazardous liquid spills. The pertinent characteristics of 90 hazardous liquids and 28 sorbent materials are reported, and a matrix is provided to indicate the tested and anticipated compatibilities between the liquids and sorbents. Some conclusions are drawn about the state-of-the-art and the suitability of various sorbent types. A comprehensive testing program is recommended.

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SECTION 1

EXECUTIVE SUMMARY

The MITRE Corporation/Metrek Division has been helping the U.S. Environmental Protection Agency (EPA) review the state-of-the-art of sorbent materials for containing and cleaning spills of hazardous liquids. This report summarizes information for EPA and provides recommendations on the use of sorbent materials for cleaning up hazardous liquid spills. The report also provides guidance to response teams that vary in sophistication from company cleanup crews and fire departments to a combined Coast Guard/EPA task force.

Because chemical spills may constitute a severe threat to human health and the environment, EPA has identified 299 hazardous substances on the basis of toxicity and likelihood of environmental discharge. Of these chemicals, 90 are liquid under ambient conditions or are shipped in liquid formulations (Appendix A). These substances represent major potential spill problems and are the central concern of this report.

Information regarding the 90 hazardous liquids is presented to help predict the behavior of the spills, the hazards posed to public health, and the potential interaction with various possible sorbent materials. The information listed for each chemical includes the Chemical Abstracts Service (CAS) number, the solubility in water, viscosity, melting and boiling points, and flash point, among others.

Sorbent materials can be divided into three general classifications: natural organic (e.g., straw, feathers), natural inorganic (e.g., clays, calcium carbonate), and synthetic (e.g., polyurethane). Each of these categories differs from the other two in terms of material, origin, cost, and effectiveness. The natural organic and inorganic sorbents are generally more readily available and less expensive than the synthetic sorbents. Although more expensive, the synthetics tend to exhibit higher sorption capacity than their natural counterparts. Both natural and synthetic sorbents can be treated to improve their versatility and sorption capacity.

The criteria for sorbent selection in the event of a hazardous chemical spill are safety, sorption capacity, cost, availability, and ease of application, collection, and disposal. The safety criterion refers to avoidance of sorbent-liquid combinations that may result in explosion, fire, or generation of toxic fumes. Sorbents are generally inert materials. Thus, most combinations of hazardous liquids and sorbent materials appear to be safe. Sorption

capacity, for which relatively few data are available, is the weight of liquid sorbed per unit weight of sorbent.

The interaction of two or more hazardous substances may occur either in the same spill or as a result of the disposal at a single site of sorbents from different spills. Since these combinations may also be hazardous, unsafe combinations of hazardous liquids are identified.

Determining the compatibility between hazardous liquids and sorbent materials is limited as a result of data gaps. These limitations also exist because available data are not generally substantiated by laboratory test results, are extrapolated from oil spill cleanup operations, or are predicted from physical and chemical characteristics of the liquids and sorbents.

In spite of these limitations, the following conclusions have been drawn regarding the use of sorbents, the criteria for their selection, and their application in response to a hazardous liquid spill (see Section 3). Sorbent materials can be used to clean up spills on land and water. To minimize the environmental risk of a hazardous liquid spill, it is essential that quick selection and application of the appropriate sorbent be made.

Recommendations have been made to EPA and spill response teams (see Section 4). The recommendations to EPA involve establishing a comprehensive testing program to determine which sorbents are suitable for containing and cleaning up liquid spills on land and water. Guidelines have been formulated to determine the effectiveness and suitability of using each of 28 sorbents with each of 90 hazardous liquids. These include (1) testing substances from each category of sorbents and hazardous liquids and extrapolating the results to other substances within the category; and (2) establishing a priority range for test combinations of sorbents with hazardous liquids, from widely available and low-cost natural sorbents, to less common, more costly ones.

The recommendations to spill response teams involve selecting sorbents on the basis of (1) response requirements to hazardous liquid spills, and (2) factors related to their removal and disposal. Factors to be considered in responding to a liquid spill include safety, sorption capacity, retention capacity, and relative affinity for water. Considerations related to the removal and disposal of sorbents include the ease of collecting the material, the thoroughness of the clean-up, the means of removal, the ease of transport to the disposal site, and the requirements for safe disposal of the material.

SECTION 2

INTRODUCTION

Background

Spills of hazardous liquid substances represent a severe threat to environmental quality. These substances may pollute streams, contaminate groundwater aquifers, run off into sanitary sewer systems and upset wastewater treatment plants, or evaporate to become air pollution problems. Dealing with a spill largely depends on various uncontrollable conditions such as the weather, spill site accessibility and availability of suitable equipment, materials, and personnel. The following are typical steps in responding to a hazardous spill: Assessment, containment, treatment, removal, disposal, and monitoring.

Spill assessment includes determination of such factors as the identity and quantity of the chemical(s) spilled, the location of the spill (e.g., on land or water, or near population centers) and the hazardous properties of the chemical(s) spilled.

Containment and treatment of a hazardous liquid spill are designed to prevent its dispersal in the environment and to reduce the hazard it may pose. Various processes for containment and treatment have been described in a number of publications such as those prepared by the U.S. Environmental Protection Agency (EPA), the U.S. Department of Transportation (including the U.S. Coast Guard), various state agencies, and commercial suppliers of spill cleanup products and services (e.g., Akers et al., 1978; Arthur D. Little, 1974; Bauer et al., 1975; Michalovic et al., 1977; Pilie et al., 1975).

Removal of the hazardous liquid and subsequent cleanup of the contaminated site are the most difficult steps. In some cases, where the substratum is impermeable and the liquid is not volatile or reactive, the liquid can be pumped directly into a tank truck for transport to a disposal site. Many jurisdictions employ this technique, but, in many instances, the spilled liquid needs to be contained and removed with the aid of sorbent materials. Common, naturally occurring sorbent materials, such as straw, sawdust, bark, sand, and ash, have been used to clean up liquid spills for many years. Certain combinations of hazardous substances and sorbent materials are ineffective, however, and others are dangerous to cleanup personnel. Consequently, spill cleanup personnel need guidance concerning the selection of sorbents. After removal, the hazardous substance can be disposed of or destroyed. Disposal of hazardous solid wastes (including hazardous liquid-sorbent

combinations) is regulated by EPA under Subtitle C of the Resource Conservation and Recovery Act of 1976 [40 CFR 261.3 (c)(2)].

Once the spill has been cleaned up, monitoring the site provides an indication of the extent to which cleanup has been completed. Monitoring also allows for the evaluation and assessment of environmental damage.

Purpose

The purpose of this report is to summarize information for EPA as well as to provide recommendations concerning the use of sorbent materials for cleaning up hazardous liquid spills. The report also provides guidance to response teams varying in sophistication from a company cleanup crew to a combined Coast Guard/EPA task force. In addition, this report reviews the state-of-the-art in sorbent materials used for hazardous liquid cleanup. Characteristics and classifications are presented for hazardous substances and common sorbents selected by EPA, and indications are given of their compatibility. Finally, the report identifies data gaps and research needs in the area of hazardous liquid spill cleanup.

Scope

The report presents data on 90 hazardous substances and various commercially available sorbents; it also develops a matrix for the suitability of various sorbents for different hazardous chemical spills.

Information presented on the hazardous chemicals includes their method of selection for study in this report, and data on various properties useful in characterizing the behavior and hazard of a liquid spill (e.g., physical and chemical properties, and health and flammability hazard). The selected properties are presented for each chemical in Appendix B.

Data on various commercially available sorbent materials are presented in Appendix C. Included in the information gathered are physical characteristics (e.g., density, degradability, sorption capacity, and retention capacity) and product information (e.g., product name, generic name, and cost). Although information is presented on the three classifications of sorbents (natural, mineral, and synthetic), emphasis is placed on those that are inexpensive and readily available.

Approach

A four-step approach was used in this study:

- Identification and characterization of hazardous substances;
- Identification and characterization of sorbent materials;
- Identification of compatible liquid-sorbent combinations; and
- Identification of data gaps and research needs.

Hazardous substances were identified and characterized by selecting the 90 liquids from the EPA list of hazardous substances (EPA 1978b and EPA 1979a) and conducting a literature search to obtain information on the physical and chemical properties for each substance.

The procedures for identifying and characterizing sorbent materials were similar to those followed for hazardous substances. Generally available sorbent materials were identified from technical reports and the commercial literature. Sorbent-liquid compatibility (either proven or predicted) was identified from the literature.

Compatibilities of hazardous substances and sorbent materials were derived from three sources: (1) tested and tried combinations, (2) predicted behavior based on functional groups, and (3) claims by manufacturers. From this information, a compatibility matrix was compiled indicating the safety of the different sorbents for each hazardous liquid. Finally, throughout this report, data gaps are identified regarding hazardous materials, sorbents, and their compatibility with each other.

Limitations

The numerous limitations of this study form the basis for the section on recommendations for future study (Section 4). Data gaps are identified regarding both the characteristics of sorbents and the compatibility of the sorbent-liquid combinations. The data obtained are not generally substantiated by laboratory test results. In other instances, proprietary data have been withheld from the public by manufacturers. Although much field experience has been gained in hazardous liquid cleanup operations, results have not been documented. In addition, the time constraint involved in preparing this document did not allow for direct communication with the sorbent industry. Thus, the data presented are mainly taken from published literature.

SECTION 3

CONCLUSIONS

Response to a hazardous spill includes assessment, containment, treatment, removal, transport, disposal, and monitoring. Selection and application of suitable sorbent materials are important factors in a spill response operation and should therefore be considered in the context of the overall response to a spill.

The following conclusions can be drawn regarding sorbent materials and their application to hazardous liquid spill cleanup:

- Sorbents can be used to clean up spills on land and on the water surface (if the sorbents float and are hydrophobic).
- Criteria for selecting a sorbent include safety, sorption capacity, ease of application, collection, and disposal, as well as cost and availability. The latter two vary with time and location.
- Quick selection and application of the appropriate sorbent material are essential to minimize the environmental risk of a hazardous liquid spill.
- The natural sorbents are generally more readily available than the synthetics, although availability varies with time and location.
- Synthetic sorbents are more costly than their natural counterparts, but they are more versatile and tend to exhibit higher sorption capacity.
- Special surface treatment of both natural and synthetic sorbents can improve their versatility and sorption capacity.

SECTION 4

RECOMMENDATIONS

The recommendations resulting from this study are directed to EPA and to those responsible for cleanup of hazardous liquid spills.

Recommendations to EPA

A comprehensive testing program should be undertaken to determine the suitability of various sorbent materials for containment and cleanup of hazardous liquids spilled on land and on water. Thousands of measurements may be necessary to determine the effectiveness and suitability of using each of the 28 sorbents with each of the 90 hazardous liquids. The following guidelines are therefore recommended for use in designing a practical test program:

- Substances from each category of sorbents and hazardous liquids should be tested and the results of the tests extrapolated to other substances within the category (the categories are shown in Tables 3, 6 and 7).
- The priority for test combinations of sorbents with hazardous liquids should range from:
  - widely available, low-cost, natural sorbents with liquids produced in large amounts, to
  - less common, more costly sorbents with liquids produced in small amounts or used primarily within the confines of a manufacturing or processing facility.
- Sorbent use on land spills should be evaluated before spills on water, since the former are more likely to occur.

The product of this program should be a user's guide to the selection, procurement, application, removal, and disposal of sorbent materials for the containment, removal, and disposal of hazardous liquid spills.

Recommendations to the Spill Response Teams

The various available sorbents should be selected based on
(1) the requirements for response to a hazardous liquid spill, and
(2) the factors involved in the subsequent removal and disposal of the sorbent-liquid mixture.

The characteristics of the sorbent/hazardous liquid combinations that should be considered in responding to a hazardous liquid spill are:

- safety of the sorbent/liquid combination (generation of toxic emissions or effluents, spattering, explosion, or fire)
- sorption capacity
- retention capacity
- relative affinity for water.

Factors that should be considered in selecting a sorbent in relation to the removal and disposal of the sorbent/liquid mixture include:

- ease of collecting the mixture
- thoroughness of cleanup to prevent potential secondary pollution of the site
- means of removal from the spill site
- ease of transport to the disposal site
- requirements for safe disposal of the mixture.

SECTION 5

HAZARDOUS SUBSTANCES

The basis for selecting the 90 hazardous substances for study in this report is discussed in this section. In addition, specific properties that would characterize the behavior of a hazardous substance are identified and discussed. These properties may be used by a spill team to select a sorbent to clean up a particular hazardous chemical spill.

Selection

The 90 hazardous chemicals examined in this report were chosen from a list of hazardous substances identified by the U.S. Environmental Protection Agency (EPA) under Section 311(B)(2)(a) of the Federal Water Pollution Control Act of 1972 as amended by the Clean Water Act of 1977. The chemicals listed by EPA were chosen on the basis of two criteria: (1) toxicity and (2) likelihood of release to the environment (EPA, 1978b). The first criterion was based primarily on a 96-hour LC_{50} of no more than 500 milligrams per liter (mg/l) for a test population of aquatic animals. The second criterion was based on factors such as history of previous spills and annual production in excess of 2200 Gg (1 billion lb.).

Those chemicals selected for study in this report were chosen to satisfy one of two additional criteria: (1) the chemical is a liquid under ambient conditions,* or (2) the chemical is shipped in liquid formulations. Eighty of the chemicals were selected from a list of 271, which appeared in the Federal Register of March 13, 1978. An additional 10 were chosen by EPA from a supplementary list of 28 hazardous substances as identified in the Federal Register of February 16, 1979.

The hazardous liquids examined in this report are listed in Appendix A. In the appendix, the chemicals are listed in alphabetical order with both their CAS number and common synonyms. In addition, the hazardous liquids are identified by the principal functional group, which partly determines the behavior and activity of the chemical substance.

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*For the purpose of this report, ambient conditions are defined as between 0°F and 100°F (-20°C and 40°C) at one atmosphere (760 mm Hg) pressure.

Properties

For the purposes of this report, the properties of the hazardous liquids that are of primary interest are those that can indicate the behavior of the spill, the hazard it poses to public health and the environment, and the interaction with various sorbent materials. These properties are listed and explained in Table 1, which also indicates the significance of the property and the units of measurement. For example, solubility in water is a property that relates to the behavior of the liquid in the environment (Table 1). This property indicates two things: (1) the likelihood of water as a dispersal medium in the environment, and (2) the feasibility of diluting a land spill with water.

Classification schemes that categorize the behavior, the hazard, or both for these 90 substances have been developed by various agencies or associations that deal with them. EPA developed a classification of "Reportable Quantities" (quantities that may be harmful), the discharge of which is a violation of the Clean Water Act, Section 311(b)(3). The U.S. Department of Transportation and the National Fire Protection Association developed hazard classifications individually. Schemes devised by these various groups are presented in Table 2.

The appropriate hazard classification and chemical and physical properties for each of the 90 hazardous substances are presented in Appendix B. These data are summarized in Tables 3 and 4. Comparisons can be made within or among functional groups of hazardous substances based on the data. The information presented in Appendix B is more complete than that in the summary table; thus, the appendix should be consulted for additional information on a particular hazardous substance.

TABLE 1

DESCRIPTION OF HAZARDOUS LIQUIDS PROPERTIES

Property	Utility Of Property			Definition/Explanation	Units
	Behavior	Hazard	Interaction		
Solubility in H_2O	X		X	Amount of substance that will dissolve in a unit volume of water at a specified temperature (usually around 25°C); reflects likelihood of dispersion in water and feasibility of diluting land spill with water	Parts per million (ppm)
Persistence	X			Reflects resistance of the substance to degradation into simpler components by natural chemical and biochemical reactions. The following rating is used: 0=not persistent; 1=persistent in atmosphere, water or soil, but may oxidize; 2=very persistent	Qualitative rating
Specific gravity	X			Ratio of the density of the substance to the density of water; reflects buoyancy in water; substances with a value >1 will generally sink	None
Viscosity	X		X	Resistance to change of form at a specified temperature; reflects likelihood of running off, percolating into soil, and adhering to sorbent materials	Centipoises (dyne-seconds/100 cm^2)
Surface tension	X		X	Resistance to removal of a unit surface area of the liquid at a specified temperature; reflects wetting ability, and hence, likelihood of adherence to sorbent	Dynes/cm
Melting and boiling points	X			Lowest and highest temperatures at which substance is in the liquid state	°C
Vapor pressure	X		X	Pressure of the vapor in equilibrium with the liquid at a specified temperature; reflects tendency to evaporate	mm of Hg
Vapor density	X			Ratio of the density of the vapor to the density of air. Reflects buoyancy of the vapor in air; vapor rises if value <1	None
Flash point		X		Minimum temperature at which sufficient amount of liquid has vaporized to form an ignitible mixture with the air	°C
Auto ignition temperature		X		Temperature at which vapors will spontaneously ignite	°C
Flammability limits		X		Lowest and highest concentration of vapor in air which will support ignition	Vol. %

NOTE: The "X" indicates the utility of each property in predicting the physical behavior (spreading, percolation, evaporation) of the spilled liquid, the hazard (explosion, fire, toxic fumes) it poses to the surrounding area, and the character of interaction (degree of sorption) with the sorbent material.

TABLE 2

DESCRIPTION OF HAZARDOUS LIQUID CLASSIFICATIONS

Classification	Significance	Reference
DOT Hazard	Classifies substances on the basis of potential hazard and assigns a letter code as follows: Combustible liquid — Comb. L. — A liquid with a flash point between 100 - 200°F. Corrosive material — Cor. — A liquid or solid that causes visible destruction in human skin tissue or severely corrodes steel Flammable liquid — F.L. — A liquid with a flash point below 100°F Other regulated material — ORM Oxidizing material — Oxy. M — A liquid or solid that yields oxygen readily upon reaction Poison A — Pois. A — A gas or liquid that is dangerous to life in small amounts Poison B — Pois. B — A liquid or solid that presents a health hazard during transportation	U.S. Department of Transportation, 1975
NFPA (National Fire Protection Association)	Rates the health hazard, flammability, and reactivity of substances on a scale of 0 (no effect) to 4 (severe effect)	
EPA Reportable Quantity	Rates the acute toxicity of substances in terms of their lethal concentrations (LC_{50}) for aquatic organisms as follows: X — 1 A — 10 B — 100 C — 1,000 D — 5,000	U.S. Environmental Protection Agency, 1980

TABLE 3

SUMMARY OF HAZARD CLASSIFICATIONS AND PROPERTIES OF HAZARDOUS LIQUIDS

	HAZARDOUS LIQUIDS		HAZARD CLASSIFICATION					PHYSICAL/CHEMICAL PROPERTIES			
			EPA REPORTABLE QUANTITY	DOT HAZARD CLASS	NFPA HAZARD RATING			SPECIFIC GRAVITY WATER = 1	VAPOR DENSITY AIR = 1	VISCOSITY (CENTIPOISES)	
					HEALTH	FLAMMABILITY	REACTIVITY			C_p	°C
ORGANIC COMPOUNDS	ACIDS and DERIVATIVES	Acetic acid	C	Cor.	2	2	1	1.0	2.1	1.3	18
		Acetic anhydride	C	Cor.	2	2	1	1.1	3.5	0.9	18
		Butyric acid	D	Cor.	2	2	0	1.0	3.0	1.8	15
		2,2-Dichloropropionic acid	D	-	-	-	-	1.4	-	-	-
		Formic acid	D	Cor.	3	2	0	1.2	1.6	18	20
		Naphthenic acid	B	-	-	-	-	1.0	-	-	-
		Propionic acid	D	Cor.	2	2	0	1.0	2.5	1.1	20
		Propionic anhydride	D	Cor.	2	2	1	1.0	4.5	-	-
	ALCOHOLS and PHENOLS	Allyl alcohol	B	F.L.	3	3	1	0.9	2.0	0.3	30
		Cresol[a]	C	Pois.B	3	2	0	1.1	3.7	20.8	20
		Phenol	C	Pois.B	3	2	0	1.1	3.2	3.5	50
	ALDEHYDES and KETONES	Acetaldehyde	C	F.L.	2	4	2	0.8	1.5	0.2	20
		Acrolein	X	F.L.	3	3	2	0.8	1.9	-	-
		Crotonaldehyde	B	F.L.	3	3	2	0.9	2.4	-	-
		Formaldehyde	C	ORM	2	2	0	1.0	1.1	-	-
		Furfural	C	Comb.L	1	2	1	1.2	3.3	1.5	25
	EPOXIDES	Propylene Oxide	D	F.L.	2	4	2	0.8	2.0	0.3	20

CONTINUED

TABLE 3

		HAZARDOUS LIQUIDS	HAZARD CLASSIFICATION					PHYSICAL/CHEMICAL PROPERTIES			
			EPA REPORTABLE QUANTITY	DOT HAZARD CLASS	NFPA HAZARD RATING			SPECIFIC GRAVITY WATER = 1	VAPOR DENSITY AIR = 1	VISCOSITY (CENTIPOISES)	
					HEALTH	FLAMMABILITY	REACTIVITY			C_p	°C
ORGANIC COMPOUNDS	ESTERS	Amyl acetate	C	F.L.	1	3	0	0.9	4.5	0.8	45
		Butyl acetate	D	F.L.	1	3	0	0.9	4.0	0.7	20
		n-Butyl phthalate	B	-	0	1	0	1.0	9.6	16.5	25
		Methyl methacrylate	D	F.L.	2	3	2	0.94	3.5	-	-
		Pyrethrins	C	-	-	-	-	1.5	-	-	-
		Vinyl acetate	C	F.L.	2	3	2	0.9	3.0	-	-
	HALOGEN COMPOUNDS	Acetyl bromide	D	Cor.	-	-	-	1.7	-	-	-
		Acetyl chloride	D	F.L.	3	3	2	1.1	2.7	-	-
		Allyl chloride	C	F.L.	3	3	1	0.9	2.6	0.3	30
		Benzoyl chloride	C	Cor.	3	2	1	1.2	4.9	-	-
		Benzyl chloride	B	Cor.	2	2	1	1.1	4.4	-	-
		Carbon tetrachloride	D	ORM	3	0	0	1.6	5.3	1.0	20
		Chlordane	X	Comb.L	-	-	-	1.6	-	-	-
		Chlorobenzene	B	F.L.	2	3	0	1.1	3.9	0.8	20
		Chloroform	D	ORM	2	0	0	1.5	-	0.6	20
		Cyanogen chloride	A	Pois.A	-	-	-	1.2	2.1	-	-
		o-Dichlorobenzene	B	ORM	2	2	0	1.3	5.1	1.3	25
		Dichloropropene - dichloropropane (D-D mix)	D	Cor.	2	3	0	1.2	3.9	-	-
		2,2-Dichloropropionic acid	D	-	-	-	-	1.4	-	-	-

CONTINUED

TABLE 3

ORGANIC COMPOUNDS	HAZARDOUS LIQUIDS		HAZARD CLASSIFICATION						PHYSICAL/CHEMICAL PROPERTIES			
			EPA REPORTABLE QUANTITY	DOT HAZARD CLASS	NFPA HAZARD RATING				SPECIFIC GRAVITY WATER = 1	VAPOR DENSITY AIR = 1	VISCOSITY (CENTIPOISES)	
					HEALTH	FLAMMABILITY	REACTIVITY				C_p	^oC
	HALOGEN COMPOUNDS (con't)	Hexachlorocyclopentadiene	X	-	-	-	-		1.7	9.4	-	-
		Phosgene (under pressure)	D	Pois.A	4	0	0		1.4	3.4	-	-
		Polychlorinated biphenyls (PCB's)	A	-	-	-	-		1.2-1.5	-	-	-
		Trichloroethylene	C	ORM	1	1	0		1.5	4.5	0.6	20
		Vinylidene chloride	D	-	2	4	2		1.3	3.3	-	-
	HYDROCARBONS	Benzene	C	F.L.	2	3	0		0.9	2.8	0.65	20
		Cyclohexane	C	F.L.	1	3	0		0.8	2.9	0.7	20
		Ethylbenzene	C	F.L.	2	3	0		0.9	3.7	0.7	17
		Isoprene	C	F.L.	2	4	1		0.7	2.4	-	-
		Styrene	C	F.L.	2	3	2		0.9	3.6	-	-
		Toluene	C	F.L.	2	3	0		0.9	3.1	0.6	17
		Xylene*	C	F.L.	2	3	0		0.9	3.7	0.6	20
	NITROGEN COMPOUNDS	Acetone cyanohydrin	A	Pois.B	4	1	2		0.9	2.9	-	-
		Acrylonitrile	B	F.L.	4	3	2		0.8	1.8	-	-
		Aniline	C	Pois.B	3	2	0		1.0	3.2	10.2	0
		Benzonitrile	C	-	-	-	-		1.0	-	1.2	25
		Butylamine	C	F.L.	2	3	0		0.7	2.5	-	-
		Diethylamine	C	F.L.	2	3	0		0.7	2.5	0.4	25
		Dimethylamine	C	F.L.	3	4	0		0.7	1.6	-	-

CONTINUED

TABLE 3

	HAZARDOUS LIQUIDS		HAZARD CLASSIFICATION					PHYSICAL/CHEMICAL PROPERTIES			
			EPA REPORTABLE QUANTITY	DOT HAZARD CLASS	NFPA HAZARD RATING			SPECIFIC GRAVITY WATER = 1	VAPOR DENSITY AIR = 1	VISCOSITY (CENTIPOISES)	
					HEALTH	FLAMMABILITY	REACTIVITY			C_p	^oC
ORGANIC COMPOUNDS	NITROGEN COMPOUNDS (con't)	Dinitrotoluene[a]	C	-	2	1	3	1.5	6.3	-	-
		Ethylenediamine	C	-	3	2	0	0.9	2.1	-	-
		Hydrogen cyanide	A	Pois.A	4	4	2	0.7	0.9	-	-
		Monoethylamine	C	F.L.	3	4	0	0.8	1.6	-	-
		Nitrobenzene	C	Pois.B	3	2	0	1.2	4.3	2.0	20
		Quinoline	C	-	-	-	-	1.1	4.5	0.6	17
		Triethylamine	B	F.L.	2	3	0	0.8	3.5	-	-
		Trimethylamine	C	F.L.	2	4	0	0.7	2.0	-	-
	ORGANOMETALLIC COMPOUNDS	Tetraethyl lead	B	Pois.B	3	2	3	1.7	8.6	-	-
	ORGANOPHOSPHORUS COMPOUNDS	Diazinon	X	ORM	-	-	-	1.1	-	-	-
		Dichlorvos	A	-	-	-	-	1.4	-	-	-
		Disulfoton	A	-	-	-	-	1.1	-	-	-
		Ethion	A	-	-	-	-	1.2	-	-	-
		Malathion	A	ORM	-	-	-	1.2	2.3	-	-
		Methyl parathion	B	Pois.B	4	1	2	1.3	-	-	-
		Mevinphos	X	-	-	-	-	1.3	3.2	-	-
		Naled	A	-	-	-	-	2.0	-	-	-
		Parathion	X	Pois.B	4	1	2	1.3	-	-	-
		Tetraethyl pyrophosphate	-	-	-	-	-	-	-	-	-

CONTINUED

TABLE 3

	HAZARDOUS LIQUIDS		HAZARD CLASSIFICATION					PHYSICAL/CHEMICAL PROPERTIES			
			EPA REPORTABLE QUANTITY	DOT HAZARD CLASS	NFPA HAZARD RATING			SPECIFIC GRAVITY WATER = 1	VAPOR DENSITY AIR = 1	VISCOSITY (CENTIPOISES)	
					HEALTH	FLAMMABILITY	REACTIVITY			C_p	^oC
ORGANIC COMPOUNDS	SULFUR COMPOUNDS	Carbon disulfide	D	F.L.	2	3	0	1.3	2.6	0.4	20
		Chlorosulfonic acid	C	Cor.	-	-	-	1.8	-	-	-
		Methyl mercaptan	B	F.L.	2	4	0	0.9	1.7	-	-
INORGANIC COMPOUNDS	ACIDS	Hydrochloric acid (20% sol.)	D	Cor.	3	0	0	1.1	-	25.4	20
		Hydrofluoric acid (70% sol.)	D	Cor.	-	-	-	1.2	-	-	-
		Nitric acid	C	oxy.M	3	0	0	1.5	-	-	-
		Phosphoric acid	D	Cor.	2	0	0	1.9	-	-	-
		Sulfuric acid	C	Cor.	3	0	2	1.8	-	26.9	15
	INORGANIC HALIDES	Antimony pentachloride	C	Cor.	3	0	1	2.3	-	-	-
		Arsenic trichloride	D	Pois.B	3	0	0	2.2	-	-	-
		Phosphorous oxychloride	D	Cor.	3	0	2	1.7	6.8	-	-
		Phosphorous trichloride	D	Cor.	3	0	2	1.6	4.8	-	-
		Sodium hypochlorite (solution)	B	-	-	-	-	1.0	-	-	-
		Sulfur monochloride	C	Cor.	2	1	1	1.7	-	-	-
		Zinc chloride (solution)	D	-	-	-	-	3.0	-	-	-

CONTINUED

TABLE 3 (CONCLUDED)

INORGANIC COMPOUNDS	HAZARDOUS LIQUIDS		HAZARD CLASSIFICATION					PHYSICAL/CHEMICAL PROPERTIES			
			EPA REPORTABLE QUANTITY	DOT HAZARD CLASS	NFPA HAZARD RATING			SPECIFIC GRAVITY WATER = 1	VAPOR DENSITY AIR = 1	VISCOSITY (CENTIPOISES)	
					HEALTH	FLAMMABILITY	REACTIVITY			C_p	^oC
	OTHER	Ammonium hydroxide	C	Cor.	-	-	-	0.9	-	-	-
		Nitrogen dioxide	C	Pois.A	3	0	0	1.5	1.6	-	-

*See individual data sheets for properties of all isomers.

Notes: Data listed in this table were compiled from the sources listed in the text.
Tables 2 and 3 present detailed descriptions of the properties and classifications included in this table.

TABLE 4

SUMMARY OF HAZARD CLASSIFICATIONS AND PROPERTIES OF HAZARDOUS LIQUIDS

ORGANIC COMPOUNDS	HAZARDOUS LIQUIDS		PHYSICAL/CHEMICAL PROPERTIES											
			SURFACE TENSION (dynes/cm)		MELTING POINT (°C)	BOILING POINT (°C)	FLASH POINT (°C)	IGNITION TEMPERATURE (°C)	VAPOR PRESSURE (mm Hg)		FLAMMABILITY LIMITS (volume % in air)	SOLUBILITY IN WATER		PERSISTENCE
			d/cm	°C					mm	°C		ppm	°C	
	ACIDS and DERIVATIVES	Acetic acid	27.8	20	16.7	118	42.8	465	11.4	20	3-17	miscible	-	-
		Acetic anhydride	23.7	20	-73	140	53.9	390	5.1	25	2.9-10.3	120,000	25	-
		Butyric acid	26.8	20	-5	164	71.7	450	0.43	20	2.0-10.0	56,000	25	1
		2,2-Dichloropropionic acid	-	-	-	185-190	-	-	-	-	-	450,000	25	-
		Formic acid	37.6	20	8.4	101	68.9	601	42.4	25	18-57	miscible	-	0
		Naphthenic acid	-	-	30	233	149	-	46	38	-	2,010	25	-
		Propionic acid	26.7	20	-21	141	54.4	513	4.5	25	2.9- --	miscible	-	0
		Propionic anhydride	-	-	-45	168	73.9	-	1	26	-	decomposes	-	1
	ALCOHOLS and PHENOLS	Allyl alcohol	25.8	20	-50	96-97	21.1	378	25.6	25	2.5-18	miscible	-	1
		Cresol*	-	-	31	191	81.1	599	-	-	1.4- --	20,000	-	-
		Phenol	40.9	20	41	182	79	715	0.53	20	1.5- --	6,700	25	2
	ALDEHYDES and KETONES	Acetaldehyde	-	-	-124	21	-37.8	175	92.3	25	4-60	miscible	-	0
		Acrolein	-	-	-88	53	-26.1	235	288	25	28-31	400,000	25	0
		Crotonaldehyde	-	-	-76.5	104	13	232	30	20	2.95-15.5	181,000	20	0
		Formaldehyde	58.2	20	-92	20	85	-	1947	25	-	550,000	-	-
		Furfural	43.5	20	-36	162	60	316	2.1	25	2.1-19.3	83,000	20	0
	EPOXIDES	Propylene Oxide	-	-	-104	35	-37	449	445	20	2.1-21.5	330,000	30	0

CONTINUED

TABLE 4

ORGANIC COMPOUNDS	HAZARDOUS LIQUIDS		PHYSICAL/CHEMICAL PROPERTIES											PERSISTENCE
			SURFACE TENSION (dynes/cm)		MELTING POINT (°C)	BOILING POINT (°C)	FLASH POINT (°C)	IGNITION TEMPERATURE (°C)	VAPOR PRESSURE (mm Hg)		FLAMMABILITY LIMITS (volume % in air)	SOLUBILITY IN WATER		
			d/cm	°C					mm	°C		ppm	°C	
	ESTERS	Amyl acetate	-	-	-78.5	150	25	360	7.4	25	1.1-7.5	2,000	20	-
		Butyl acetate	-	-	-74	126	22.2	425	15	25	1.7-7.6	7,000	20	1
		n-Butyl phthalate	33.4	20	-	340	157	402	-	-	0.5- --	400	25	2
		Methyl methacrylate	-	-	-48	101	10/0°C	-	30	26	1.7-8.2	1,600	20	1
		Pyrethrins	-	-	0	de-composes	-	-	-	-	-	1	-	-
		Vinyl acetate	23.9	20	-93	73	-8	427	107.5	25	-	20,000	25	1
	HALOGEN COMPOUNDS	Acetyl bromide	-	-	-96	76	<1	-	-	-	-	decomposes	-	1
		Acetyl chloride	26.7	14.8	-112	51	5	390	2	16	-	decomposes	-	-
		Allyl chloride	-	-	-135	45	-31.7	485	294.3	20	2.9-11.1	3,000	25	-
		Benzoyl chloride	-	-	-0.5	197	73	585	1	32	-	decomposes	-	-
		Benzyl chloride	-	-	-39	179	67.2	505	1.4	25	1.1- --	33	25	-
		Carbon tetrachloride	26.8	20	-23	77	none	none	91.3	20	nonflam-mable	500	-	2
		Chlordane	-	-	-	175	-	-	$1x10^{-5}$	25	-	Insoluble	-	-
		Chlorobenzene	33.6	20	-45	132	28.9	640	12.1	25	1.3-7.1	488	25	-
		Chloroform	27.1	20	-63	62	-	-	200	25	-	2,000	25	1
		Cyanogen chloride	-	-	-6	14	-	-	40	-38	-	2,500	25	-
		o-Dichlorobenzene	26.8	20	-17	181	66	648	-	-	2.2-9.2	Insoluble	-	2
		Dichloropropene - dichloropropane (D-D mix)	28.9	20	-80	96	16	557	40	19	3.4-14.5	2,700	20	-
		2,2-Dichloropropionic acid	-	-	-	185-190	-	-	-	-	-	450,000	25	-

CONTINUED

TABLE 4

ORGANIC COMPOUNDS	HAZARDOUS LIQUIDS		PHYSICAL/CHEMICAL PROPERTIES											
			SURFACE TENSION (dynes/cm)		MELTING POINT (°C)	BOILING POINT (°C)	FLASH POINT (°C)	IGNITION TEMPERATURE (°C)	VAPOR PRESSURE (mm Hg)		FLAMMABILITY LIMITS (volume % in air)	SOLUBILITY IN WATER		PERSISTENCE
			d/cm	°C					mm	°C		ppm	°C	
		Hexachlorocyclopentadiene	-	-	9.6	239	none	none	-	-	nonflammable	-	-	2
	HALOGEN COMPOUNDS (con't)	Phosgene	-	-	-118	8.2	-	-	1200	20	-	decomposes	-	0
		Polychlorinated biphenyls (PCB's)	-	-	-	325-366	-	-	<1	25	-	0.3-0.5	-	2
		Trichloroethylene	29.5	20	-73	87	32	410	100	31	12.5-90	1,000	25	2
		Vinylidene chloride	-	-	-123	32	-10	458	500	20	5.6-11.4	-	-	-
	HYDROCARBONS	Benzene	28.8	20	5.5	80	-11.1	560	94.9	25	1.3-7.1	3,000	25	1
		Cyclohexane	25.5	20	6.1	81	-20	245	98.1	25	1.3-8.0	45	25	1
		Ethylbenzene	29.2	20	-95	136	15	432	9.6	25	1.0-6.7	14	25	-
		Isoprene	-	-	-146	34	-65	493	20	-	2.9- --	100	-	0
		Styrene	32.1	19	31	146	32	490	6	25	1.1-6.1	320	25	1
		Toluene	28.5	20	-95	111	4.4	480	28.4	25	1.2-7.1	470	25	0
		Xylene*	28.9	20	-25	144	32	465	-	-	1.1-7	175	25	0
	NITROGEN COMPOUNDS	Acetone cyanohydrin	-	-	-19	95	73.9	688	-	-	2.2-12.0	100,000	-	1
		Acrylonitrile	-	-	-82	77	0	481	113.8	25	-	70,000	25	0
		Aniline	42.9	20	-6.2	184	70	615	0.67	25	1.3- --	36,000	18	-
		Benzonitrile	39.1	20	12.8	191	75	-	1	24	-	10,000	100	1
		Butylamine	19.7	41	-49	78	12.2	312	72	20	1.7-9.8	miscible	-	1
		Diethylamine	16.4	56	-50	55	-26	312	247.1	25	1.8- --	miscible	-	0
		Dimethylamine	-	-	-96	7	-7	400	1277	20	2.8-14.4	237,000	-	1

CONTINUED

TABLE 4

ORGANIC COMPOUNDS	HAZARDOUS LIQUIDS		PHYSICAL/CHEMICAL PROPERTIES											
			SURFACE TENSION (dynes/cm)		MELTING POINT (°C)	BOILING POINT (°C)	FLASH POINT (°C)	IGNITION TEMPERATURE (°C)	VAPOR PRESSURE (mm Hg)		FLAMMABILITY LIMITS (volume % in air)	SOLUBILITY IN WATER		PERSISTENCE
			d/cm	°C					mm	°C		ppm	°C	
	NITROGEN COMPOUNDS (con't)	Dinitrotoluene[a]	-	-	71	300	-	-	-	-	-	270	22	-
		Ethylenediamine	-	-	8.5	117	65.6	385	13	25	-	miscible	-	-
		Hydrogen cyanide	-	-	-14	26	-18	538	264.4	0	5.6-40.0	miscible	-	-
		Monoethylamine	-	-	-80.6	17	<21.1	385	1094	25	2.5-14.0	miscible	-	0
		Nitrobenzene	43.9	20	6	211	87.8	482	0.3	25	1.8- --	1,900	20	2
		Quinoline	17	28.5	-15	238	-	480	1	60	1.2- --	60,000	25	0
		Triethylamine	17.3	-4	-115	90	-7	-	-	-	1.2-8.0	55,000	20	-
		Trimethylamine	-	-	-117	3	-	190	687	0	2.0-11.6	475,000	30	-
	ORGANOMETALLIC COMPOUNDS	Tetraethyl lead	-	-	-137	decom-poses	933	-	1	28	-	30	25	1
	ORGANOPHOS-PHORUS COMPOUNDS	Diazinon	-	-	-	83/0.002	-	-	$1x10^{-4}$	20	-	40	25	-
		Dichlorvos	-	-	-	140/200	-	-	$3.2x10^{-2}$	32	-	10,000	20	-
		Disulfoton	-	-	-	62/0.01	-	-	$1.8x10^{-6}$	20	-	25	-	-
		Ethion	-	-	-13	-	-	-	$1.5x10^{-6}$	25	-	2	20	1
		Malathion	-	-	2.9	156	-53.9	-	$4x10^{-5}$	30	-	145	25	0
		Methyl parathion	-	-	35-36	decom-poses	46.1	-	0.97	20	-	50	25	1
		Mevinphos	-	-	-	99-103/ 0.03mm	-	-	$2.9x10^{-4}$	21	-	miscible	-	1
		Naled	-	-	27	110/0.5	54	-	$2x10^{-6}$	20	-	500	-	-
		Parathion	-	-	6	375	132	-	0.03	24	-	20	-	1
		Tetraethyl pyrophosphate	-	-	-	145-150/ 5-10mm	-	-	-	-	-	miscible	-	1

CONTINUED

TABLE 4

	HAZARDOUS LIQUIDS		PHYSICAL/CHEMICAL PROPERTIES											
			SURFACE TENSION (dynes/cm)		MELTING POINT (°C)	BOILING POINT (°C)	FLASH POINT (°C)	IGNITION TEMPERATURE (°C)	VAPOR PRESSURE (mm Hg)		FLAMMABILITY LIMITS (volume % in air)	SOLUBILITY IN WATER		PERSISTENCE
			d/cm	°C					mm	°C		ppm	°C	
ORGANIC COMPOUNDS	SULFUR COMPOUNDS	Carbon disulfide	32.3	20	-111	47	-30	90	400	28	1.3-50.0	2,200	25	1
		Chlorosulfonic acid	-	-	-80	152	-	-	1	32	-	decomposes	-	-
		Methyl mercaptan	-	-	-123	7	<0	-	760	7	3.9-21.8	24,000	15	-
INORGANIC COMPOUNDS	ACIDS	Hydrochloric acid (20% sol.)	70	20	-62	109	-	-	1	146	-	832,000	25	2
		Hydrofluoric acid (70% sol.)	-	-	-75	65	-	-	400	3	-	miscible	-	-
		Nitric acid	-	-	-42	86	-	-	7.1	40	-	miscible	-	-
		Phosphoric acid	-	-	47.3	decomposes	-	-	-	-	-	miscible	-	2
		Sulfuric acid	55.1	20	10	290	-	-	$3x10^{-4}$	-	-	miscible	-	2
	INORGANIC HALIDES	Antimony pentachloride	-	-	2.8	79/22mm	-	-	1	23	-	decomposes	-	-
		Arsenic trichloride	-	-	-8.5	131	-	-	1	24	-	decomposes	-	-
		Phosphorous oxychloride	-	-	1.3	107	-	-	28	20	-	decomposes	-	-
		Phosphorous trichloride	-	-	-112	76	-	-	100	21	-	decomposes	-	0
		Sodium hypochlorite (solution)	-	-	57.5	-	-	-	-	-	-	293,000	0	-
		Sulfur monochloride	-	-	-82	138	118	239	10	28	-	decomposes	-	-
		Zinc chloride (solution)	-	-	290	732	-	-	100	690	-	$4.3x10^{6}$	25	-

CONTINUED

TABLE 4 (CONCLUDED)

INORGANIC COMPOUNDS	HAZARDOUS LIQUIDS	PHYSICAL/CHEMICAL PROPERTIES											
		SURFACE TENSION (dynes/cm)		MELTING POINT (°C)	BOILING POINT (°C)	FLASH POINT (°C)	IGNITION TEMPERATURE (°C)	VAPOR PRESSURE (mm Hg)		FLAMMABILITY LIMITS (volume % in air)	SOLUBILITY IN WATER		PERSISTENCE
		d/cm	°C					mm	°C		ppm	°C	
OTHER	Ammonium hyrdoxide	-	-	-77	30	-	-	11.9	20	16-25	miscible	-	1
	Nitrogen dioxide	-	-	-9.3	21	-	-	760	21	-	decomposes	-	-

*See individual data sheets for properties of all isomers

Notes: Data listed in this table were compiled from the sources listed in the text.
Tables 1 and 2 present detailed descriptions of the properties and classifications included in this table.

SECTION 6

SORBENTS

This section identifies and characterizes sorbent materials used for containing and cleaning up hazardous liquids. The nature and classification of sorbents and sorbent characteristics are examined, and available data on the sorbents are presented.

Nature and Classification

Sorbent materials are usually inert, nontoxic, solid substances that are used to clean up hazardous liquid spills. Four reasons exist for sorbent use: to prevent spreading or percolation of the liquid, to reduce rate of evaporation, to condition for treatment, and to facilitate removal and safe disposal.

Use of sorbent materials for containment and cleanup of hazardous liquids has evolved from cleanup technology originally devised for oil spills. Spanning a wide spectrum of forms and compositions, these sorbents can be grouped into three classifications: natural organic (natural), natural inorganic (mineral), and synthetic. The origin, composition, and representative sorbent materials of each classification are presented in Table 5. As can be seen, the synthetic sorbents have the greatest diversity in material type because a modification of either the natural or mineral sorbents is considered to be synthetic. In addition, numerous polymeric materials such as polyethylene or polystyrene have also been used and are considered effective synthetic sorbents.

These three sorbent classes generally differ on availability and sorption capacity. The natural sorbents, both organic and inorganic, are generally more readily available and less expensive than the synthetic ones. The synthetic sorbents are characterized by greater versatility and sorption capacity. For example, multipurpose gelling agent (MGA) (a mixture of four synthetic polymers and a silica fluidizing agent) was developed to immobilize the four most common types of hazardous liquids: aqueous solutions, alcohols, polar organic compounds, and nonpolar organic compounds (Michalovic et al., 1975). One common factor among the sorbent types is that organic sorbents tend to have a greater sorption and retention capacity for organic rather than inorganic liquids.

Sorption of liquids occurs through one of two processes: adsorption and absorption. In adsorption, a weak chemical bond is formed between the liquid and the surface of the sorbent particles. In absorption, the liquid is

TABLE 5

CLASSIFICATION OF SORBENT MATERIALS

Class	Origin	Common Materials
Natural Organic (Natural)	Animal or vegetable	• Straw, sawdust, bark, peat, rice hulls, peanut hulls, bagasse, corn cobs, cotton waste, wool waste, feathers
Natural Inorganic (Mineral)	Mineral	• Sand, clays (bentonite, kaolinite), fly ash, spent lime, calcium carbonate, diatomaceous earth, perlite, vermiculite, rock wool
Synthetic or Modified Natural	Synthetic polymeric materials (e.g. polyethylene, polypropylene, polystyrene, polyurethane), animal or vegetable, and mineral	• Modified Organic: Conwed (surface treated cellulose), Slikwik (ground corn cobs), Sorb-Oil (recycled fiberboard) • Modified Inorganic: Zorbite (formulated perlite) Diasorb (silica particles), Absorbent 1012 (treated volcanic rock), Filtrasorb (activated charcoal) • Organic/Inorganic: Fiberperl, Sorbent C (mixtures of cellulose and perlite) • Foams: Durable Conwed, Graboil, Spill Control PEP • Mats: Leomat, Quick-Wik, Tafmat, 3 M sheets • Strands: Oil Snare, 3 M Fibres • Particles: Imbiber Beads, Rubbermaid Beground Rubber • Mixed Form: Winkler Foams • Multipurpose Gelling Agent

mechanically entrapped within the pores and interstices of the sorbent material through capillary action.

Sorbents may be used on land, where most spills occur, or on inland waterways.* Because contact between the liquid sorbent is easier to establish with spills on land than on water, land spills are more effectively cleaned up by sorbents. For spills on waterways, sorbents are most effective when both the hazardous liquid and sorbent material float on the surface. This rarely occurs because only 10 of the hazardous liquids examined in this report float on water, although most of the sorbents float.** More commonly, the hazardous liquid is dispersed in the water and does not float. In this case, the hydrophobic sorbents will sorb the hazardous liquid selectively. This type of spill is the most difficult to clean effectively.

Characteristics

Selection of the most appropriate sorbent for a given application is governed by:

- Availability and cost
- Storage and transportation requirements
- Safety
- Sorption capacity
- Ease of use (i.e., application and removal)
- Disposal

Of these, the two most important in selecting a sorbent for a hazardous spill are safety and sorption capacity. These two and other characteristics are discussed more fully below.

Availability is an important consideration because of the need for a quick response to spills of hazardous chemicals. The availability of many of the natural sorbents may be seasonal, especially if a large storage facility is not available for keeping a stock of these lowest-cost sorbents. Alternatively, the synthetic sorbents can be readily obtained from the manufacturer year-round, but for a higher cost.

Some of the sorbents are bulky and require protection from weathering. For these, storage may be an important consideration. For example, sorbents that are susceptible to weathering should be stored in a warehouse or in weatherproof containers.

Most sorbents are inert materials and do not usually cause safety problems in combination with hazardous liquids. However, some sorbents may present problems because of the combustibility of the sorbent or the reaction

*The use of sorbents for containing hazardous liquid spills in open bays or oceans is not considered in this report.

**The few sorbents that are denser than water include untreated cellulose and untreated minerals such as sand or clay.

between the sorbent and liquid, resulting in explosion or ignition of the hazardous liquid. An explosion or fire involving a hazardous liquid may produce toxic fumes.

Sorption capacity indicates the weight of liquid sorbed per unit weight of sorbent. This information allows assessment of the proper amount of sorbent needed to contain the spill. The sorbent capacity--either through adsorption or absorption--depends on certain qualities of the spilled liquid. Viscosity of the liquid is the most important variable in the sorption process because it affects absorption and adsorption in different ways. Viscosity is inversely proportional to temperature. Generally, as viscosity increases, absorption of the liquid into the interstices and capillaries of the sorbent decreases. Alternatively, high viscosity causes an increase in adsorption by promoting adherence between both the liquid molecules and the liquid-sorbent molecules. Selection of a sorbent will be based partly on the ambient temperature during use.

The ease with which a sorbent can be applied and removed is an important criterion that depends on the physical state of the sorbent material, the extent of the spill, and the location of the spill (i.e., on land or water). Sheets, pillows, pads, baths, and booms are deployed by hand; but chips, granules, and other particles can be dispersed by mechanical blowers or spreaders. For spills on water, sorbents may be distributed by boats or aircraft. Removal of the sorbent-liquid combination is generally accomplished manually, although mechanical means may aid in the collection of the sorbent. For example, consolidated materials are picked up manually, whereas the collection of loose sorbents is typically aided by skimming or vacuuming.

If air emissions or leaching of hazardous substances can be controlled, disposal of the contaminated sorbent material may be accomplished either through incineration or landfill. In some cases, treatment such as neutralization may be necessary before disposal.

Information useful for identifying and procuring sorbent materials is presented in Table 6 along with characteristics for predicting performance. The significance of selected sorbent characteristics, existing units of measurement, and references are also presented in this table. Most sorbent characteristics, unlike those of hazardous liquids, have no units of measurement and are generally expressed in qualitative terms.

Data available on sorbent materials are presented in Appendix C and summarized in Table 7. The appendix contains more information than the summary table and should be consulted for additional information on a sorbent.

Sorbent materials can be divided by cost into three different groups. First, the natural organic and inorganic sorbents are the least expensive, with costs ranging between $0.01 and $0.02 per pound. Second, treated minerals (a type of synthetic sorbent) have a cost range of $0.30 to $0.40 per pound. Third, the synthetic polymerics may vary in cost from $2.50 to $4.40 per pound. The sorption capacity generally increases with the price, but not as rapidly. Thus, the least expensive sorbents are generally the most cost effective.

TABLE 6

DESCRIPTION OF CHARACTERISTICS OF SORBENT MATERIALS

CHARACTERISTICS	SIGNIFICANCE	UNITS
Brand or Common Name	E.g., Conwed, Diasorb, vermiculite	
Generic Name or Description	E.g., treated cellulose, polyurethane foam	
Molecular Formula	Indicates chemical and biological activity	Structure/activity relationship
Form	E.g., 3 x 6' mats, 10-100 mesh granules	
Manufacture/Processor	Contact information for manufacturer or processor	
Material Cost	Cost per unit weight of sorbent material	$/lb
Density	Reflects ability to float	g/y^3, lbs/ft^3
Degradability	Susceptibility to natural chemical or biological degradation	Quality rating
Flammability	Susceptibility to combustion	Quality rating
Toxicity	Capability of harming living organisms	Quality rating
Sorption Capacity	Capability of sorbing a specified liquid	lbs. liquid/lbs. material
Retention Capacity	Capability of retaining a sorbed liquid	Quality statement
Affinity for Water	Tendency to sorb water	Quality rating

TABLE 7

SELECTED CHARACTERISTICS OF SORBENT MATERIALS

MATERIALS	DESCRIPTION	DENSITY (g/cm^3)	DEGRADABILITY, FLAMMABILITY, TOXICITY			SORPTIVE CAPACITY (lbs subst/lb sorbent)	COST ($/lb)	REFERENCE
			NATURAL ORGANIC					
feathers, wool			high	very high	none			
cellulose (straw, sawdust, bark, hulls, peat)	strands, chips, powder	1.0	high	very high	none		0.01-0.02	(g)
			TREATED ORGANIC					
Conwed	treated cellulose fiber	0.05	fair	high		benzene: 12.6 phosph. acid: 5	1.36-4.40	(c)(d)(g)
Slikwik	ground corn cob powder	0.14	high	high	none		0.11	(g)
Sorb-Oil	recycled fiberboard mats, booms, or chips		high	very high	none			
			NATURAL MINERALS					
calcium carbonate	white, slightly basic powder		none	none			0.01-0.02	(c)
ash, sand			none	none				
perlite	expanded and treated silicate glass granules		none	none	none			
vermiculite	expanded magnesium silicate granules	0.07	none	none	none	phosph. acid: 6.5		(d)(g)
			TREATED MINERALS					
Absorbent 1012	expanded and treated volcanic rock granules	0.1	none	none	none	general: 5-7	0.33	(b)(g)

TABLE 7

MATERIALS	DESCRIPTION	DENSITY (g/cm^3)	DEGRADABILITY, FLAMMABILITY, TOXICITY	SORPTIVE CAPACITY (lbs subst/lb sorbent)	COST ($/lb)	REFERENCE
Disorb	silicate glass foam granules	0.04	none none very low	acrylonitrile: 10.2; benzene: 10.6; formaldehyde (37%): 8.6; nitric acid (70%): 20; phenol (83%): 15.5 phosphoric acid (85%): 28; sulfuric acid (96%): 19.2; toluene/ xylene:		(d)(h)
Oil-Dri	crushed and expanded montmorillonite clay	0.48-0.56	none none none	acrylonitrile: 0.7; benzene: 0.7; formaldehyde (37%): 0.7; nitric acid (70%): 2.2; phenol (83%): 1.2; phosphoric acid (85%): 2.0; sulfuric acid (96%): 1.7; toluene/ xylene: 0.8	0.35	(h)
Zorbite	expanded and treated silicate glass granules	0.14	none none none			(g)
			ORGANIC/MINERAL			
Fiberperl	mixture of expanded perlite and cellulose fiber	0.07	low high none		0.31	(e)
Sorbent C	mixture of expanded perlite and cellulose fiber	0.07	low high none			(b)(g)
			POLYETHYLENE			
Conved-D	closed-cell, mechanically modified foam pads	0.04	none low none		3.59	(g)

CONTINUED

TABLE 7

MATERIALS	DESCRIPTION	DENSITY (g/cm^3)	DEGRADABILITY, FLAMMABILITY, TOXICITY	SORPTIVE CAPACITY (lbs subst/lb sorbent)	COST ($/lb)	REFERENCE
			POLYPROPYLENE			
3M	polypropylene fiber in sheets, booms, granules	0.05	none fair none	benzene: 10.0 chloroform: 17.8	2.30-4.40	(a)(g)(i)
Oil Mop	polypropylene fiber rope or mop	0.6-0.9	none fair none			(b)
Oil Snare	polypropylene strands	0.5 0.14	none fair none		2.50	(b)(g)
Quick-Wick	treated polypropylene fiber mats, rolls	0.04	none fair none			(g)
			POLYURETHANE			
Graboil	treated polyurethane foam sheets or booms	0.02	none fair (generates HCN on combustion) none	general: 20		(b)(g)
Petro-Trap	polyurethane		none fair (generates HCN on combustion) none	benzene: 18.8		(c)
Spill Control	polyurethane foam sheets, pads, booms		none fair (generates HCN on combustion) none			(g)
SCC Absorbent	treated polyurethane in sheets and granules	0.27	none fair (generates HCN on combustion) none	general: 40-60		(a)(b)
			CROSS-LINKED POLYMERS			
Imbiber Beads	cross-linked copolymer granules	0.64 0.98	very low none	general: up to 27	2.65	(a)(b)(g

CONTINUED

TABLE 7 (CONCLUDED)

MATERIALS	DESCRIPTION	DENSITY (g/cm^3)	DEGRADABILITY, FLAMMABILITY, TOXICITY	SORPTIVE CAPACITY (lbs subst/lb sorbent)	COST ($/lb)	REFERENCE
			MIXED POLYMERS			
Winkler Foams	mixture of polystyrene beads with other materials	0.02	none fair			(g)
MULTI-PURPOSE GELLING AGENT (MGA)[1]	mixture of 4 polymeric and 1 mineral powder		very low		2.50	(f)
			CARBON			
Activated Carbon	varies from powder to granules		very low none none	0.02-0.2	-	(a)(c)

SOURCES: (a) Akers et al., 1978.
(b) Arthur D. Little, 1974.
(c) Bauer et al., 1975.
(d) Diamond Shamrock Corp.1979.
(e) Grefco, Inc.
(f) Pilie et al., 1975.
(g) Robertson, 1978.
(h) Temple et al., 1978.
(i) 3M Co., 1978.

[1] MGA is composed of polyacrylamide, fumed silica, polytertiary butyl styrene, polycarboxymethylcellulose, polyacrylonitrile rubber.

Sorption of Hazardous Liquids

Although experimental and field data are limited, the available information on compatibilities of hazardous liquids and selected sorbent materials is compiled in Tables 8 and 9. Useful liquid-sorbent combinations are indicated by a check (√), and unsafe combinations are indicated by a cross (X). In cases where the sorption capacity is known, the check is replaced by the reported value.

The hazardous liquids presented in Table 8 are listed by their functional chemical groups. This arrangement permits ready comparison of data for the liquids in a given functional category and extrapolation of the usefulness and safety of the various untested combinations. For example, data may exist for a particular hazardous substance in combination with one or more sorbents. This information may be useful in selecting a sorbent to be used in cleaning up a spill involving another substance within the same functional group for which data do not exist. The safety and effectiveness of a selected but untested sorbent should be determined with a small amount of the spilled liquid under controlled conditions before an actual cleanup operation is undertaken.

As indicated by the numerous data gaps in the table, data on liquid-sorbent combinations are generally not available. In some cases, the available data are from extrapolations based on various properties of the hazardous substances (e.g., viscosity, surface tension, and specific gravity). Documentation of sorption effectiveness for all categories of sorbent materials is generally inadequate and particularly poor for the natural organic sorbents.

For individual hazardous liquids, information deficiencies exist for chlordane, dichloropropionic acid, methyl mercaptan, monoethylamine, naphthenic acid, phosgene, propionic acid, pyrethrins, and most of the organophosphorous compounds. Among the inorganic liquids, the principal data gaps are for ammonium hydroxide, antimony pentachloride, arsenic trichloride, nitrogen dioxide, sodium hypochlorite, sulfur monochloride, and zinc chloride.

TABLE 8*

COMPATIBILITY OF HAZARDOUS LIQUIDS AND SELECTED SORBENT MATERIALS

	HAZARDOUS LIQUIDS		SORBENT MATERIALS: ANIMAL MATERIALS[a]	CARBON, ACTIVATED	CELLULOSE[b]	CELLULOSE, CONED[c]	MINERALS, CALCIUM CARBONATE	MINERALS, OTHER[d]	MINERALS, TREATED RAZORB[e]	PERLITE AND CELLULOSE, TREATED: FIBERPERL[f] SORBENT C[g]	POLYPROPYLENE: 3M OIL SORBENT[h]	POLYPROPYLENE: OIL SNARE[i] QUICK-WICK[j]	OTHER POLYOLEFINS
ORGANIC COMPOUNDS	ACIDS and DERIVATIVES	Acetic acid	-	✓	-	✓	-	✓	-	-	✓	-	-
		Acetic anhydride	-	✓	-	✓	-	✓	13[q]	-	✓	-	-
		Butyric acid	-	✓	✓	✓	-	✓	-	-	✓	-	-
		2,2-Dichloropropionic acid	-	-	-	-	-	-	-	-	-	-	-
		Formic acid	-	✓	-	✓	-	✓	-	-	-	-	-
		Naphthenic acid	-	✓	-	✓	-	✓	-	-	✓	-	-
		Propionic acid	-	✓	-	✓	-	✓	-	-	-	-	-
		Propionic anhydride	-	✓	-	-	-	-	-	-	✓	-	-
	ALCOHOLS and PHENOLS	Allyl alcohol	-	✓	-	✓	✓	-	10	-	✓	-	-
		Cresol	-	✓	✓	✓	-	✓	13	-	✓	-	✓
		Phenol	-	✓	✓	✓	-	✓	15	-	-	-	-
	ALDEHYDES and KETONES	Acetaldehyde	-	✓	-	✓	-	✓	11	-	✓	✓	-
		Acrolein	-	✓	-	✓	-	-	-	-	✓	-	-
		Crotonaldehyde	-	✓	-	-	-	-	-	-	-	-	-
		Formaldehyde	-	✓	x[r]	x	-	✓	10	-	✓	-	-
		Furfural	-	✓	-	✓[p]	-	✓	-	-	✓	-	-
	EPOXIDES	Propylene oxide	-	✓	-	-	-	✓	-	-	✓	-	-
	ESTERS	Amyl acetate[s]	-	✓	✓	✓[p]	-	-	9	-	✓	✓	✓
		Butyl acetate	-	✓	✓	✓	-	✓	11	-	✓	✓	✓
		n-Butyl phthalate	-	✓	-	-	-	✓	-	-	✓	-	-
		Methyl methacrylate[s]	-	✓	✓	✓	-	✓	11	-	✓	✓	✓
		Pyrethrins	-	-	-	-	-	-	-	-	✓	-	-
		Vinyl acetate	-	✓	✓	✓[p]	-	✓	8	-	✓	✓	✓

*References for both Table 8 and Table 9 are found at the end of Table 9.

TABLE 8

HAZARDOUS LIQUIDS	SORBENT MATERIALS	ANIMAL MATERIALS[a]	CARBON, ACTIVATED	CELLULOSE[b]	CELLULOSE, CONVED[c]	MINERALS, CALCIUM CARBONATE	MINERALS, OTHER[d]	MINERALS, TREATED HAZORB[e]	PERLITE AND CELLULOSE, TREATED	POLYPROPYLENE		OTHER POLYOLEFINS
									FIBERPERL[f] SORBENT CB	3M OIL SORBENT[h]	OIL SNARE QUICK-WICK[j]	
ORGANIC COMPOUNDS												
HALOGEN COMPOUNDS	Acetyl bromide	-	✓	-	✓	-	-	-	-	✓	-	-
	Acetyl chloride	-	✓	-	✓	-	-	-	-	✓	-	-
	Allyl chloride	-	✓	✓	✓	-	-	-	-	✓	✓	✓
	Benzoyl chloride[g]	-	✓	-	-	✓	-	-	-	✓	-	✓
	Benzyl chloride	-	✓	-	-	✓	✓	-	-	✓	-	-
	Carbon tetrachloride	-	✓	-	-	-	✓	19	-	✓	-	-
	Chlordane	-	✓	-	-	-	-	-	-	✓	-	-
	Chlorobenzene	-	✓	-	✓[p]	-	✓	12	-	✓	-	-
	Chloroform	-	✓	-	✓[p]	-	✓	12	-	18	✓	✓
	Cyanogen chloride	-	✓	-	✓	-	-	-	-	-	-	✓
	O-Dichlorobenzene	-	✓	-	-	-	✓	-	-	-	-	-
	Dichloropropene-dichloropropane (D-D mixture)	-	✓	-	-	-	-	-	-	✓	-	-
	2,2-Dichloropropionic acid	-	-	-	-	-	-	-	-	-	-	-
	Hexachlorocyclopentadiene	-	-	-	-	-	-	-	-	✓	-	-
	Phosgene	-	✓	-	-	-	-	-	-	-	-	-
	Polychlorinated biphenyls (PCB's)	-	✓	-	-	-	✓[ee]	10	-	✓	-	✓
	Trichloroethylene	-	✓	-	-	-	✓	13	-	✓	-	-
	Vinylidene chloride	-	✓	-	-	-	-	-	-	✓	-	-
HYDROCARBONS	Benzene[g]	-	✓	✓	✓	-	✓	11	6	10	✓	-
	Cyclohexane[g]	-	✓	✓	✓	-	✓	7	-	✓	✓	-
	Ethylbenzene[g]	-	✓	✓	✓	-	✓	9	-	✓	✓	✓
	Isoprene[g]	-	✓	✓	✓	-	✓	-	-	✓	✓	✓
	Styrene[g]	-	✓	✓	✓	-	✓	9	-	✓	✓	✓
	Toluene[g]	-	✓	✓	✓[p]	-	1	11	-	✓	✓	✓
	Xylene[g]	-	✓	✓	✓[p]	-	1	11	-	✓	✓	✓

CONTINUED

TABLE 8

	HAZARDOUS LIQUIDS	SORBENT MATERIALS	ANIMAL MATERIALS[a]	CARBON, ACTIVATED	CELLULOSE	CELLULOSE, CONVED[c]	MINERALS, CALCIUM CARBONATE	MINERALS, OTHER[d]	MINERALS, TREATED HAZORB[e]	PERLITE AND CELLULOSE, TREATED: FIBERPERL[f] SORBENT C[g]	POLYPROPYLENE: 3M OIL SORBENT[h]	POLYPROPYLENE: OIL-SNARE QUICK-WICK[i]	OTHER POLYOLEFINS
ORGANIC COMPOUNDS	NITROGEN COMPOUNDS	Acetone cyanohydrin	-	✓	-	✓	-	✓	-	-	✓	-	-
		Acrylonitrile	-	✓	✓	✓	-	✓	10	-	✓	-	✓
		Aniline	-	✓	-	✓	-	✓	17	-	✓	-	-
		Benzonitrile	-	✓	-	✓	-	-	-	-	✓	-	-
		Butylamine	-	✓	-	✓	-	✓	-	-	✓	-	-
		Diethylamine	-	✓	-	✓	-	✓	6	-	✓	✓	-
		Dimethylamine	-	✓	-	-	-	-	-	-	✓	✓	-
		Dinitrotoluene	-	✓	-	-	-	-	-	-	-	-	-
		Ethylenediamine	-	✓	-	-	-	-	-	-	✓	-	-
		Hydrogen cyanide	-	✓	-	-	✓	-	-	-	-	-	-
		Monoethylamine	-	✓	-	✓	-	✓	-	-	✓	-	-
		Nitrobenzene	-	✓	-	✓	-	✓	-	-	✓	-	-
		Quinoline	-	✓	-	✓	-	-	-	-	✓	-	-
		Triethylamine	-	✓	-	✓	-	-	-	-	-	-	✓
		Trimethylamine	-	✓	-	✓	-	✓	-	-	✓	-	-
	ORGANOMETALLIC COMPOUNDS	Tetraethyl lead	-	✓	-	✓	-	✓	-	-	✓	-	-
	ORGANOPHOSPHORUS COMPOUNDS	Diazinon	-	✓	-	-	-	✓	-	-	✓	-	-
		Dichlorvos	-	✓	-	-	-	✓	-	-	✓	-	-
		Disulfoton	-	✓	-	-	-	✓	-	-	✓	-	-
		Ethion	-	✓	-	-	-	✓	-	-	✓	-	-
		Malathion	-	✓	-	-	-	✓	-	-	✓	-	-
		Methyl parathion	-	✓	-	-	-	✓	-	-	-	-	-
		Mevinphos	-	✓	-	-	-	✓	-	-	✓	-	-
		Naled	-	✓	-	-	-	✓	-	-	✓	-	-
		Parathion	-	✓	-	-	-	✓	-	-	✓	-	-
		Tetraethyl pyrophosphate	-	✓	-	-	-	-	-	-	✓	-	-

CONTINUED

TABLE 8 (CONCLUDED)

	HAZARDOUS LIQUIDS / SORBENT MATERIALS		ANIMAL MATERIALS[a]	CARBON, ACTIVATED	CELLULOSE[b]	CELLULOSE, CONED[c]	MINERALS, CALCIUM CARBONATE	MINERALS, OTHER[d]	MINERALS, TREATED HAZORB	PERLITE AND CELLULOSE, TREATED	POLYPROPYLENE		OTHER POLYOLEFINS
										FIBERPERL[f] SORBENT C8	3M OIL SORBENT[h]	OIL-SNARE QUICK-WICK[j]	
ORGANIC COMPOUNDS	SULFUR COMPOUNDS	Carbon disulfide	-	✓	-	✓	-	✓	-	-	✓	-	-
		Chlorosulfonic acid	-	✓	-	-	-	✓	-	-	✓	-	-
		Methyl mercaptan	-	✓	-	-	-	-	-	-	-	-	-
INORGANIC COMPOUNDS	ACIDS	Hydrochloric acid	x	✓	x	x	✓	✓	14	-	✓	-	-
		Hydrofluoric acid	x	✓	x	x	✓	✓	-	-	-	-	-
		Nitric acid	x	✓	x	x	✓	✓	20	-	✓	-	-
		Phosphoric acid	x	✓	x	x	✓	✓	26	-	✓	-	-
		Sulfuric acid	x	✓	x	x	✓	✓	19	-	✓	-	-
	INORGANIC HALIDES	Antimony pentachloride	-	✓	-	-	-	-	-	-	-	-	-
		Arsenic trichloride	-	✓	-	-	-	-	-	-	✓	-	-
		Phosphorous oxychloride	-	✓	-	-	✓	-	-	-	✓	-	-
		Phosphorous trichloride	-	✓	-	-	✓	-	-	-	✓	-	-
		Sodium hypochlorite (solution)	-	✓	-	-	-	-	-	-	-	-	-
		Sulfur monochloride	-	✓	-	-	-	-	-	-	✓	-	-
		Zinc chloride (solution)	-	✓	-	-	-	▲	-	-	-	-	-
	OTHER	Ammonium hydroxide	-	✓	-	-	-	-	12	-	-	-	-
		Nitrogen dioxide	-	✓	-	-	✓	-	-	-	-	-	-
	REFERENCES		u	v,w	x	y	x	z,ee	aa,bb	x	v,cc	x	x

TABLE 9

COMPATIBILITY OF HAZARDOUS LIQUIDS AND SELECTED SORBENT MATERIALS

	HAZARDOUS LIQUIDS / SORBENT MATERIALS		POLYURETHANES			CROSS-LINKED COPOLYMER, STYRENE BEADS[a]	MULTI-PURPOSE GELLING AGENT
			GRABOIL[b]	PETRO-TRAP[b]	SSC ABSORBENT[a]		
ORGANIC COMPOUNDS	ACIDS and DERIVATIVES	Acetic acid	-	-	-	-	✓
		Acetic anhydride	-	-	-	-	✓
		Butyric acid	-	-	-	-	✓
		2,2-Dichloropropionic acid	-	-	-	-	-
		Formic acid	-	-	-	-	✓
		Naphthenic acid	-	-	-	-	✓
		Propionic acid	-	-	-	-	✓
		Propionic anhydride	-	-	-	-	-
	ALCOHOLS and PHENOLS	Allyl alcohol	-	-	-	-	-
		Cresol	-	-	✓	-	✓
		Phenol	-	✓	-	-	✓
	ALDEHYDES and KETONES	Acetaldehyde	-	✓	-	-	✓
		Acrolein	-	-	-	-	-
		Crotonaldehyde	-	-	-	-	-
		Formaldehyde	-	-	-	-	✓
		Furfural	-	-	-	-	✓
	EPOXIDES	Propylene oxide	-	-	-	-	✓
	ESTERS	Amyl acetate[a]	-	-	✓	-	-
		Butyl acetate	-	-	✓	-	✓
		n-Butyl phthalate	-	-	-	-	✓
		Methyl methacrylate[a]	-	-	✓	-	✓
		Pyrethrins	-	-	-	-	-
		Vinyl acetate	-	-	✓	-	✓

TABLE 9

ORGANIC COMPOUNDS	HAZARDOUS LIQUIDS	SORBENT MATERIALS	POLYURETHANES			CROSS-LINKED COPOLYMER IMBIBER BEADS[m]	MULTI-PURPOSE GELLING AGENT
			GRABOIL[k]	PETRO-TRAP[l]	SSC ABSORBENT[m]		
	HALOGEN COMPOUNDS	Acetyl bromide	-	-	-	-	-
		Acetyl chloride	-	-	-	-	-
		Allyl chloride	-	-	✓	-	-
		Benzoyl chloride	-	-	✓	-	-
		Benzyl chloride	-	-	-	✓	✓
		Carbon tetrachloride	-	-	-	✓	✓
		Chlordane	-	-	-	✓	✓
		Chlorobenzene	-	-	-	✓	✓
		Chloroform	-	-	✓	✓	✓
		Cyanogen chloride	-	-	✓	-	-
		o-Dichlorobenzene	-	-	-	✓	✓
		Dichloropropene-dichloropropane (D-D mixture)	-	-	-	✓	-
		2,2-Dichloropropionic acid	-	-	-	-	-
		Hexachlorocyclopentadiene	-	-	-	✓	-
		Phosgene	-	-	-	-	-
		Polychlorinated biphenyls (PCB's)	-	-	-	✓	✓
		Trichloroethylene	-	-	-	✓	✓
		Vinylidene chloride	-	-	-	-	-
	HYDROCARBONS	Benzene[n]	14	19	✓	✓	✓
		Cyclohexane[n]	-	-	-	-	✓
		Ethylbenzene[n]	-	-	✓	✓	✓
		Isoprene[n]	-	-	-	✓	✓
		Styrene[n]	-	-	✓	✓	✓
		Toluene[n]	-	-	✓	✓	✓
		Xylene[n]	-	-	✓	✓	✓

CONTINUED

TABLE 9

	HAZARDOUS LIQUIDS / SORBENT MATERIALS		POLYURETHANES				
			GRABOIL[k]	PETRO-TRAP[l]	SSC ABSORBENT[m]	CROSS-LINKED COPOLYMER IMBIBER BEADS[n]	MULTI-PURPOSE GELLING AGENT
ORGANIC COMPOUNDS	NITROGEN COMPOUNDS	Acetone cyanohydrin	-	-	-	-	✓
		Acrylonitrile	-	-	✓	-	✓
		Aniline	-	-	-	-	✓
		Benzonitrile	-	-	-	-	-
		Butylamine	-	-	-	-	✓
		Diethylamine	-	-	✓	-	✓
		Dimethylamine	-	-	✓	-	-
		Dinitrotoluene	-	-	-	-	-
		Ethylenediamine	-	-	✓	-	✓
		Hydrogen cyanide	-	-	-	-	-
		Monoethylamine	-	-	-	-	✓
		Nitrobenzene	-	-	-	-	✓
		Quinoline	-	-	-	-	-
		Triethylamine	-	-	✓	-	✓
		Trimethylamine	-	-	-	-	✓
	ORGANOMETALLIC COMPOUNDS	Tetraethyl lead	-	-	-	-	-
	ORGANOPHOSPHORUS COMPOUNDS	Diazinon	-	-	-	-	✓
		Dichlorvos	-	-	-	-	✓
		Disulfoton	-	-	-	-	✓
		Ethion	-	-	-	-	✓
		Malathion	-	-	-	-	✓
		Methyl parathion	-	-	-	-	✓
		Mevinphos	-	-	-	-	✓
		Naled	-	-	-	-	✓
		Parathion	-	-	-	-	✓
		Tetraethyl pyrophosphate	-	-	-	-	-

CONTINUED

TABLE 9 (CONCLUDED)

	HAZARDOUS LIQUIDS	SORBENT MATERIALS	POLYURETHANES: GRABOIL[k]	POLYURETHANES: PETRO-TRAP[l]	POLYURETHANES: SSC ABSORBENT[m]	CROSS-LINKED COPOLYMER IMBIBER BEADS[n]	MULTI-PURPOSE GELLING AGENT
ORGANIC COMPOUNDS	SULFUR COMPOUNDS	Carbon disulfide	-	-	-	-	✓
		Chlorosulfonic acid	-	-	-	-	✓
		Methyl mercaptan	-	-	-	-	✓
INORGANIC COMPOUNDS	ACIDS	Hydrochloric acid	-	-	-	-	-
		Hydrofluoric acid	-	-	-	-	-
		Nitric acid	-	-	-	-	-
		Phosphoric acid	-	-	-	-	-
		Sulfuric acid	-	-	-	-	✓
	INORGANIC HALIDES	Antimony pentachloride	-	-	-	-	-
		Arsenic trichloride	-	-	-	-	-
		Phosphorous oxychloride	-	-	-	-	-
		Phosphorous trichloride	-	-	-	-	-
		Sodium hypochlorite (solution)	-	-	-	-	-
		Sulfur monochloride	-	-	-	-	-
		Zinc chloride	-	-	-	-	-
	OTHER	Ammonium hydroxide	-	-	-	-	✓
		Nitrogen dioxide	-	-	-	-	-
	REFERENCES		x	x	v,x	v	z,dd

REFERENCES FOR TABLES 8 AND 9

[a] Wool, feathers, leather shavings.

[b] Bark, hulls, peat moss, sawdust, straw.

[c] Proprietary product of Conwed Corporation. Information is abstracted from company's advertising materials.

[d] Ash, clays, perlite, sand, vermiculite.

[e] Proprietary product of Diamond Shamrock Corporation.

[f] Proprietary product of Grefco, Inc.

[g] Proprietary product of Clean Water, Inc.

[h] Proprietary product of 3M Company. Information is abstracted from company's advertising materials.

[i] Proprietary product of Parker Systems, Inc.

[j] Proprietary product of Clark-Cutler-McDermott Company.

[k] Proprietary product of RBH Cybernetics, Ltd.

[l] Proprietary product of Best Textile Company.

[m] Proprietary product of Sorbent Sciences Corporation.

[n] Proprietary product of Dow Chemical Company.

[o] "-" Indicates data was not available and
"/" represents compatible combinations as found in the literature referenced.

[p] Conclusion based on experimental data.

[q] Numbers represent absorption capacity (mass of material sorbed per unit mass of sorbent), based on experimental data.

[r] "x" Represents incompatible combinations.

[s] Insoluble floater.

[t] Calcium carbonate should not be used on concentrated acids.

[u] Bocard C., P. Renault and J. Croquette, 1979. "Cleaning Products Used in Operations After the Amoco Cadiz Disaster", pp 163-167, in Proceedings of the 1979 Oil Spill Conference, March 1979, Los Angeles, California. API Publication No. 4308, American Petroleum Institute, Washington, D.C.

[v] Akers, C. K., R. J. Pilie, and J. G. Michalovic, 1978. Guidelines for the Use of Chemicals in Removing Hazardous Substance Discharges. Draft, prepared under Contract No. 68-03-2093 for National Environmental Research Center, U.S. Environmental Protection Agency, Cincinnati, OH.

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[y] Conwed Corporation, 1976. Sorbents and Hazardous Materials Data Sheet, Form 615-056. Conwed Corporation, St. Paul, MN.

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[aa] Diamond Shamrock Corporation, 1979. "Hazorb™ Universal Absorbent for Hazardous Substances" Technical Bulletin SP-LDS-4C, Diamond Shamrock Corporation, Cleveland, OH.

[bb] Temple, R.E., W.T. Gooding, P.F. Woerner, and G.F. Bennett, 1978. "A New Universal Sorbent For Hazardous Spills", pp 382-383, in Proceedings of 1978 National Conference on Control of Hazardous Material Spills, April 1978, Miami Beach, FL. Information Transfer, Inc., Rockville, MD.

[cc] 3M Company, 1978. "3M Oil Sorbent and Hazardous Liquid Materials", Technical Bulletin No. 78-1. Occupational Health and Safety Products Division, 3M Company, Saint Paul, MN.

[dd] Michalovic, J.G., C.K. Akers, R.E. Baier, and R.J. Pilie, 1977. Multipurpose Gelling Agent and Its Application to Spilled Hazardous Substances. EPA-600/2-77-151, Industrial Environmental Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, OH.

[ee] Andesite of California, Inc., 1980. "SAFESTEP Product Bulletin and Specifications." Andesite of California, Inc., Los Angeles, CA.

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APPENDIX A

LIST OF HAZARDOUS LIQUIDS

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Acetaldehyde	75-07-0	Aldehydes and Ketones
Acetic acid	64-19-7	Organic Acids and Derivatives
Acetic acid butyl ester (See: Butyl acetate)		
Acetic acid ethylene ether (See: Vinyl acetate)		
Acetic aldehyde (See: Acetaldehyde)		
Acetic anhydride	108-24-7	Organic Acids and Derivatives
Acetic oxide (See: Acetic anhydride)		
Acetone cyanohydrin	75-86-5	Nitrogen Compounds
Acetyl bromide	506-96-7	Halogen Compounds
Acetyl chloride	75-36-5	Halogen Compounds
Acetyl oxide (See: Acetic anhydride)		
Acraldehyde (See: Acrolein)		
Acrolein	107-02-8	Aldehydes and Ketones
Acryaldehyde (See: Acrolein)		
Acrylic aldehyde (See: Acrolein)		
Acrylonitrile	107-13-1	Nitrogen Compounds
Allyl alcohol	107-18-6	Alcohols and Phenols

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Allyl chloride	107-05-1	Halogen Compounds
Alpha hydroxyisobutyronitrile (See: Acetone cyanohydrin)		
Aminobenzene (See: Aniline)		
Aminobutane (See: Butylamine)		
Aminoethane (See: Monoethylamine)		
Aminophen (See: Aniline)		
Ammonium hydroxide	1336-21-6	Inorganic Compounds: Other
Amyl acetate (amylacetic ester)		
n-	628-63-7	Esters
iso-	123-92-2	
sec-	676-38-0	
tert-	625-16-1	
Aniline	62-53-3	Nitrogen Compounds
Aniline oil (See: Aniline)		
Antimony pentachloride	7647-18-9	Inorganic Halides
Aqua fortis (See Nitric acid)		
Arochlor (See: Polychlorinated Biphenyls)		
Arsenic chloride (See: Arsenic Trichloride)		

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Arsenic trichloride	7784-34-1	Inorganic Halides
Arsenious chloride (See: Arsenic trichloride)		
Arsenous chloride (See: Arsenic trichloride)		
Banana oil (See Amyl acetate)		
Basudin (See: Diazinon)		
1-Benzazine (See: Quinoline)		
Benzene	71-43-2	Hydrocarbons
Benzene chloride (See: Chlorobenzene)		
Benzenecarbonyl chloride (See: Benzoyl chloride)		
1,2-Benzene dicarboxylic acid, dibutyl ester (See: n-Butyl phthalate)		
Benzol (See: Benzene)		
Benzonitrile	100-47-0	Nitrogen Compounds
Benzo(b)pyridine (See: Quinoline)		
Benzoyl chloride	98-88-4	Halogen Compounds
Benzyl chloride	100-44-7	Halogen Compounds
Bleach (See: Sodium hypochlorite)		
Butanoic acid (See: Butyric acid)		

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
1-Butanol- 3-methyl acetate		
2-Butenal (See: Crotonaldehyde)		
Butter of arsenic (See: Arsenic trichloride)		
Butter of zinc (See: Zinc chloride)		
Butyl acetate,		
n-	123-86-4	Esters
iso-	110-19-0	
sec-	105-46-4	
tert-	540-88-5	
Butylamine,		
n- (Aminobutane)	109-73-9	Nitrogen Compounds
iso- (2-Methyl-1-propanamine)	78-81-9	
sec- ((s)-2-Butanamine)	513-49-5	
tert- (2-Methyl-2-propanamine)	75-64-9	
n-Butyl phthalate	84-74-2	Esters
Butyric acid		
n-	107-92-6	Organic Acids and Derivatives
iso-	79-31-2	
Carbolic acid (See: Carbon disulfide)		
Carbon disulfide	75-15-0	Sulfur Compounds
Carbon tetrachloride	56-23-5	Halogen Compounds

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Carbonyl chloride (See: Phosgene)		
Chinoleine (See: Quinoline)		
Chlordan (See: Chlordane)		
Chlordane	57-74-9	Halogen Compounds
Chlorallylene (See: Allyl chloride)		
Chlorobenzene	108-90-7	Halogen Compounds
Chloroform	67-86-3	Halogen Compounds
Chloroformyl chloride (See: Phosgene)		
Chloromethyl benzene (See: Benzyl chloride)		
3-Chloropropene (See: Allyl chloride)		
3-Chloropropylene (See: Allyl chloride)		
Chlorosulfonic acid	7790-94-5	Sulfur Compounds
Cinnamene (See: Styrene)		
Cinnamol (See: Styrene)		

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Cresol mixture (Cresylic acid)	1319-77-3	Alcohols and Phenols
m-	108-39-4	
o-	95-48-7	
p-	106-44-5	
Crotonaldehyde	4170-30-3	Aldehydes and Ketones
Cyanobenzene (See: Benzontrile)		
Cyanoethylene (See: Acrylonitrile)		
Cyanogen chloride	506-77-4	Halogen Compounds
Cyclohexane	110-82-7	Hydrocarbons
Cyclohexanecarboxylic acid (See: Napththenic acid)		
Dalapon (See: 2,2-Dichloropropionic acid)		
D-D mixture (See: Dichloropropene-Dichloropropane)		
DDVP (See: Dichlorvos)		
1,2-Diaminoethane (See: Ethylenediamine)		
Diazinon	333-41-5	Organophosphorus Compounds
Diazitol (See: Diazinon)		
Dibrom (See: Naled)		

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
n-Dibutyl phthalate (See: n-Butyl phthalate		
Dichlorobenzene	25321-22-6	Halogen Compounds
o-	95-50-1	
p- (solid)	106-46-7	
1,1 Dichloroethene (See: Vinylidene chloride)		
1,1-Dichloroethylene (See: Vinylidene chloride)		
Dichloropropane (see mixture below)		
Dichloropropene (see mixture below)		
Dichloropropene-Dichloropropane mixture	8003-19-8	Halogen Compounds
2,2-Dichloropropionic acid	75-99-0	Organic Acids and Derivatives
2,2-Dichlorovinyl dimethyl phosphate (See: Dichlorvos)		
Dichlorvos (DDVP)	62-73-7	Organophosphorus Compounds
Diethylamine	109-89-7	Nitrogen Compounds
Dimethylamine	124-40-3	Nitrogen Compounds
Dimethylbenzene (See: Xylene)		
Dimethyl parathion (See: Methyl parathion)		
Dinitrotoluene	25321-14-6	Nitrogen Compounds

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Diphosgene (See: Phosgene)		
Dipofene (See: Diazinon)		
Disulfoton	298-04-4	Organophosphorus Compounds
Di-Syston (See: Disulfoton)		
Dithiocarbonic anhydride (See: Carbon disulfide)		
DNT (See: Dinitrotoluene)		
DNTP (See: Parathion)		
Epichlorohydrin		
Ethanol (See: Acetaldehyde)		
Ethion	563-12-2	Organophosphorus Compounds
Ethylacetic acid (See: Butyric acid)		
Ethyl aldehyde (See: Acetaldehyde)		
Ethylamine (See: Monoethylamine)		
Ethylbenzene	100-41-4	Hydrocarbons
Ethylenediamine	107-15-3	Nitrogen Compounds
Ethylene dibromide		
Ethylene dichloride		

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Ethylene trichloride (See: Trichloroethylene)		
Ethyl methylene (See: Ethion)		
Fluohydric acid (See: Hydrofluoric acid)		
Formaldehyde	50-00-0	Aldehydes and Ketones
Formalin (See: Formaldehyde)		
Formic acid	64-18-6	Organic Acids and Derivatives
Fumigrain (See: Acrylonitrile)		
2-Furaldehyde (See: Furfural)		
Furfural	98-01-1	Aldehydes and Ketones
Glacial acetic acid (See: Acetic acid)		
Hexachlorocyclopentadiene	77-47-4	Halogen Compounds
Hexahydrobenzene (See: Cyclohexane)		
Hexahydrobenzoic acid (See: Naphthenic acid)		
Hydrochloric acid	7647-01-0	Inorganic Acids
Hydrocyanic acid (See: Hydrogen cyanide)		
Hydrofluoric acid	7664-39-3	Inorganic Acids

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Hydrogen chloride (See: Hydrochloric acid)		
Hydrogen cyanide	74-90-8	Nitrogen Compounds
Hydroxybenzene (See: Phenol)		
Hydroxytoluene (See: Cresol)		
Isoprene	78-79-5	Hydrocarbons
Kyanol (See: Aniline)		
Lead tetraethyl (See: Tetraethyl lead)		
Leucol (See: Quinoline)		
Leucoline (See: Quinoline)		
Malathion	121-75-5	Organophosphorus Compounds
Mercaptomethane (See: Methyl mercaptan)		
Methacrylic acid methyl ester (See: Methyl methacrylate		
Methanethiol (See: Methyl mercaptan)		
Methanoic acid (See: Formic acid)		
Methyl aldehyde (See: Formaldehyde)		
Methylbenzene (See: Toluene)		

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
2-Methyl-1,3-butadiene (See: Isoprene)		
2-Methyllactonitrile (See: Acetone cyanohydrin)		
Methyl mercaptan	74-93-1	Sulfur Compounds
Methyl methacrylate	80-62-6	Esters
Methyl-2-methyl-2-propenoate (See: Methyl methacrylate)		
Methyl parathion	298-00-0	Organophosphorus Compounds
Methyl sulfhydrate (See: Methyl mercaptan)		
Mevinphos	7786-34-7	Organophosphorus Compounds
Monochlorobenzene (See: Chlorobenzene)		
Monoethylamine	75-04-7	Nitrogen Compounds
Muriatic acid (See: Hydrochloric acid)		
Naled	300-76-5	Organophosphorus Compounds
Naphthenic acid	1338-24-5	Organic Acids and Derivatives
Nialate (See: Ethion)		
Niran (See: Parathion)		
Nitric acid	7697-37-2	Inorganic Acids

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Nitrobenzene	98-95-3	Nitrogen Compounds
Nitrobenzol (See: Nitrobenzene)		
Nitrogen dioxide	10102-44-0	Inorganic Compounds: Other
Nitrogen tetroxide (See: Nitrogen dioxide)		
Nitrotoluene		
Nitrox-80 (See: Methyl parathion)		
Oil of Mirbane (See: Nitrobenzene)		
Oil of Vitriol (See: Sulfuric acid)		
Oleum (See: Sulfuric acid)		
Orthophosphoric acid (See: Phosphoric acid)		
Oxybenzene (See: Phenol)		
Parathion	56-38-2	Organophosphorus Compounds
PCB (See: Polychlorinated biphenyls)		
Pentyl acetate (See: Amyl acetate)		
Perchloromethane (See: Carbon tetrachloride)		
Phenol	108-95-2	Alcohols and Phenols

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Phenylamine (See: Aniline)		
Phenyl cyanide (See: Benzonitrile)		
Phenylethane (See: Ethylbenzene)		
Phenylethylene (See: Styrene)		
Phenyl hydroxide (See: Phenol)		
Phenylmethane (See: Toluene)		
Phosdrin (See: Mevinphos)		
Phosgene	75-44-5	Halogen Compounds
Phosphoric acid	7664-38-2	Inorganic Acids
Phosphorodithioate (See: Ethion)		
Phosphorus chloride (See: Phosphorus oxychloride or Phosphorus trichloride)		
Phosphorus oxychloride	10025-87-3	Inorganic Halide
Phosphorus trichloride	7719-12-2	Inorganic Halide
Phosphoryl chloride (See: Phosphorus oxychloride)		
Phosphothion (See: Malathion)		

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Polychlorinated biphenyls	1336-36-3	Halogen Compounds
Polychlorinated diphenyls (See: Polychlorinated biphenyls)		
Prioderm (See: Malathion)		
Propanoic acid (See: Propionic acid)		
Propanoic anhydride (See: Propionic anhydride)		
Propargite		
2-Propenal (See: Acrolein)		
Propenenitrile (See: Acrylonitrile)		
Propene oxide (See: Propylene oxide)		
2-Propen-1-ol (See: Allyl alcohol)		
Propionic acid	79-09-4	Organic Acids and Derivatives
Propionic anhydride	123-62-6	Organic Acids and Derivatives
Propylene aldehyde (See: Crotonaldehyde)		
Propylene oxide	75-56-9	Epoxides
Pyrethrins		
I	121-21-1	Esters
II	121-29-9	

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Pyromucic aldehyde (See: Furfural)		
Quinoline	91-22-5	Nitrogen Compounds
Sodium hypochlorite	7681-52-9	Inorganic Halides
Spectracide (See: Diazinon)		
Styrene	100-42-5	Hydrocarbons
Styrol (See: Styrene)		
Styrolene (See: Styrene		
Sulfur chloride (See: Sulfur monochloride)		
Sulfuric acid	7664-93-9	Inorganic Acids
Sulfur monochloride	10025-67-9	Inorganic Halides
Sulfuric chlorohydrin (See: Chlorosulfonic acid)		
TEL (See: Tetraethyl lead)		
TEPP (See: Tetraethyl pyrophosphate)		
Tetrachloromethane (See: Carbon tetrachloride)		
Tetraethyl lead	78-00-2	Organometallic Compounds
Tetraethyl pyrophosphate	107-49-3	Organophosphorus Compounds

CONTINUED

APPENDIX A

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
TMA (See: Trimethylamine)		
Toluene	108-88-3	Hydrocarbons
Toluol (See: Toluene)		
Toxichlor (See: Chlordane)		
Trichloroethylene	79-01-6	Halogen Compounds
Trichloromethane (See: Chloroform)		
Triethylamine	121-44-8	Nitrogen Compounds
Trimethylamine	77-50-3	Nitrogen Compounds
Vapona (See: Dichlorvos)		
Ventox (See: Acrylonitrile)		
Vidden D (See: Dichloropropene-Dichloropropane)		
Vinegar acid (See: Acetic acid)		
Vinyl acetate	108-05-4	Esters
Vinylbenzene (See: Styrene)		
Vinyl carbinol (See: Allyl alcohol)		
Vinyl cyanide (See: Acrylonitrile)		

CONTINUED

APPENDIX A (CONCLUDED)

HAZARDOUS SUBSTANCE	CAS NO.	CHEMICAL GROUP
Vinylidene chloride	75-35-4	Halogen Compounds
Xylene (mixed)	1330-20-7	Hydrocarbons
m-	108-38-3	
o-	95-47-6	
p-	106-42-3	
Zinc chloride	7646-85-7	Inorganic Halides

SOURCE: U.S. Environmental Protection Agency, Water Programs. Hazardous Substances. Federal Register, Vol. 43, No. 49, March 13, 1978; and Vol. 44, No. 34, Part IV, February 16, 1979.

Notes: The chemical name underlined is used in the reference documents and in this report. Synonyms for these chemicals are also included with reference to the primary listing.

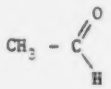
CAS NO. = Chemical Abstract Series Number

APPENDIX B

HAZARDOUS SUBSTANCES DATA SHEETS

IDENTIFICATION

- NAME: ACETALDEHYDE
- CAS NO.: 75070
- SYNONYMS: Ethanal, ethyl aldehyde, acetic aldehyde
- MOLECULAR FORMULA: C_2H_4O
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.8
- VAPOR DENSITY (air=1): 1.5
- VISCOSITY (centipoises): 0.2 @ 20°C
- SURFACE TENSION (dynes/cm): -
- MELTING POINT (°C): -123.5
- BOILING POINT (°C): 21
- FLASH POINT (°C): -37.8
- IGNITION TEMP. (°C): 175
- VAPOR PRESSURE (mm Hg): 92.3 @ 25°C
- FLAMMABILITY LIMITS: 4-60 (vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 0

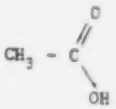
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 4 REACTIVITY: 2
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ACETIC ACID
- CAS NO.: 64197
- SYNONYMS: Ethanoic acid, glacial acetic acid, vinegar acid, methanecarboxylic acid
- MOLECULAR FORMULA: $C_2H_4O_2$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.0
- VAPOR DENSITY (air=1): 2.1
- VISCOSITY (centipoises): 1.3 @ 18°C
- SURFACE TENSION (dynes/cm): 27.8 @ 20°C
- MELTING POINT (°C): 16.7
- BOILING POINT (°C): 118
- FLASH POINT (°C): 42.8
- IGNITION TEMP. (°C): 465
- VAPOR PRESSURE (mm Hg): 11.4 @ 20°C
- FLAMMABILITY LIMITS: 3-17 (vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): -

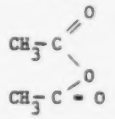
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 2 REACTIVITY: 1
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ACETIC ANHYDRIDE
- CAS NO.: 108427
- SYNONYMS: Acetic oxide, acetyl oxide
- MOLECULAR FORMULA: $C_4H_6O_3$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.1
- VAPOR DENSITY (air=1): 3.5
- VISCOSITY (centipoises): 0.9 @ 18°C
- SURFACE TENSION (dynes/cm):: 23.7 @ 20°C
- MELTING POINT (°C): -73
- BOILING POINT (°C): 140
- FLASH POINT (°C): 53.9
- IGNITION TEMP. (°C): 390
- VAPOR PRESSURE (mm Hg): 5.1 @ 25°C
- FLAMMABILITY LIMITS: 2.9 - 10.3 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 120,000 @ 25°C
- PERSISTENCE (0 to 2 rating):

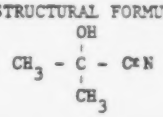
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 2 REACTIVITY: 1
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ACETONE CYANOHYDRIN
- CAS NO.: 75865
- SYNONYMS: 2-methyllactonitrile, alpha-hydroxyisobutyronitrile
- MOLECULAR FORMULA: C_4H_7NO
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 2.9
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -19
- BOILING POINT (°C): 95
- FLASH POINT (°C): 73.9
- IGNITION TEMP. (°C): 687.8
- VAPOR PRESSURE (mm Hg):
- FLAMMABILITY LIMITS: 2.2-12.0 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 100,000
- PERSISTENCE (0 to 2 rating): 1

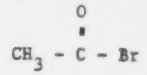
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: A
- NFPA HAZARD RATING: 4 HEALTH: 4 FLAMMABILITY: 1 REACTIVITY: 2
- DOT HAZARD CLASS: Pois. B

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ACETYL BROMIDE
- CAS NO.: 506967
- SYNONYMS:
- MOLECULAR FORMULA: C_2H_3BrO
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.7
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -96
- BOILING POINT (°C): 76
- FLASH POINT (°C): <1
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg):
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): Decomposes
- PERSISTENCE (0 to 2 rating): 1

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ACETYL CHLORIDE
- CAS NO.: 79367
- SYNONYMS:
- MOLECULAR FORMULA: C_2H_3ClO
- STRUCTURAL FORMULA:

$$CH_3 - \overset{\overset{O}{\|}}{C} - Cl$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.1
- VAPOR DENSITY (air=1): 2.7
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm): 26.7 @ 14.8°C
- MELTING POINT (°C): -112
- BOILING POINT (°C): 51
- FLASH POINT (°C): 5
- IGNITION TEMP. (°C): 390
- VAPOR PRESSURE (mm Hg): 2 @ 16°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): decomposes
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 3 REACTIVITY: 2
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ACROLEIN
- CAS NO.: 107028
- SYNONYMS: 2-propenal, acrylic aldehyde, acrylaldehyde, acraldehyde
- MOLECULAR FORMULA: C_3H_4O
- STRUCTURAL FORMULA:

$$CH_2 = CH - \overset{O}{\overset{\|}{C}}H$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.84
- VAPOR DENSITY (air=1): 1.9
- VISCOSITY (centipoises): -
- SURFACE TENSION (dynes/cm): -
- MELTING POINT (^oC): -88
- BOILING POINT (^oC): 52.5
- FLASH POINT (^oC): -26.1
- IGNITION TEMP. (^oC): 235
- VAPOR PRESSURE (mm Hg): 288.2 @ 25^oC
- FLAMMABILITY LIMITS: 28-31 (vol. % in air)
- SOLUBILITY IN WATER (ppm): 400,000 @ 25^oC
- PERSISTENCE (0 to 2 rating): 0

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: X
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 3 REACTIVITY: 2
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ACRYLONITRILE
- CAS NO.: 107131
- SYNONYMS: Propeneitrile, vinyl cyanide, cyanoethylene, Fumigrain, Ventox
- MOLECULAR FORMULA: C_3H_3N
- STRUCTURAL FORMULA:

$$CH_2 = CH - C \equiv N$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.8
- VAPOR DENSITY (air=1): 1.8
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -82
- BOILING POINT (^{o}C): 77.3
- FLASH POINT (^{o}C): 0
- IGNITION TEMP. (^{o}C): 481.1
- VAPOR PRESSURE (mm Hg): 113.8 @ 25^{o}C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 70,000 @ 25^{o}C
- PERSISTENCE (0 to 2 rating): 0

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: 4 FLAMMABILITY: 3 REACTIVITY: 2
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ALLYL ALCOHOL
- CAS NO.: 107186
- SYNONYMS: 2-propen-1-ol, 1-propenal-3, vinyl carbinol
- MOLECULAR FORMULA: C_3H_6O
- STRUCTURAL FORMULA:

$$CH_2 = CH - CH_2OH$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 2.0
- VISCOSITY (centipoises): 0.3 @ 30°C
- SURFACE TENSION (dynes/cm): 25.8 @ 20°C
- MELTING POINT (°C): -50
- BOILING POINT (°C): 96-97
- FLASH POINT (°C): 21.1
- IGNITION TEMP. (°C): 378.3
- VAPOR PRESSURE (mm Hg): 25.6 @ 25°C
- FLAMMABILITY LIMITS: 2.5-18 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 1

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 3 REACTIVITY: 1
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ALLYL CHLORIDE
- CAS NO.: 107051
- SYNONYMS: 3-chloropropene, 3-chloropropylene, chlorallylene
- MOLECULAR FORMULA: C_3H_5Cl
- STRUCTURAL FORMULA:

$$CH_2 = CH - CH_2 - Cl$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 2.6
- VISCOSITY (centipoises): 0.3 @ 30°C
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -134.5
- BOILING POINT (°C): 45
- FLASH POINT (°C): -31.7
- IGNITION TEMP. (°C): 485
- VAPOR PRESSURE (mm Hg): 294.3 @ 20°C
- FLAMMABILITY LIMITS: 2.9-11.1 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 3,000 @ 25°C
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 3 REACTIVITY: 1
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: AMMONIUM HYDROXIDE
- CAS NO.: 1336216
- SYNONYMS:
- MOLECULAR FORMULA: H_5NO
- STRUCTURAL FORMULA: $NH_4 - OH$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -77
- BOILING POINT (^{o}C): 30 (28% solution)
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 11.9 @ 20^{o}C
- FLAMMABILITY LIMITS: 16-25 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 1

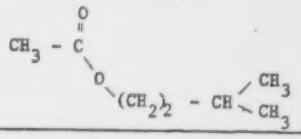
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: AMYL ACETATE
- CAS NO.: 628637
- SYNONYMS: Amylacetic ester (iso-CAS No. 123922); pear oil (sec -CAS No. 626380); banana oil (tert-CAS No. 625161)
- MOLECULAR FORMULA: $C_7H_{14}O_2$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 4.5
- VISCOSITY (centipoises): 0.8 @ 45°C
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -78.5
- BOILING POINT (°C): 150
- FLASH POINT (°C): 25
- IGNITION TEMP. (°C): 360
- VAPOR PRESSURE (mm Hg): 7:4 @ 25°C
- FLAMMABILITY LIMITS: 1.1 - 7.5 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 2,000 @ 20°C
- PERSISTENCE (0 to 2 rating):

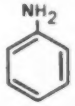
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 1 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ANILINE
- CAS NO.: 62533
- SYNONYMS: Aniline oil, phenylamine, aminobenzene, aminophen, kyanol
- MOLECULAR FORMULA: C_6H_7N
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.0
- VAPOR DENSITY (air=1): 3.2
- VISCOSITY (centipoises): 10.2 @ 0°C
- SURFACE TENSION (dynes/cm): 42.9 @ 20°C
- MELTING POINT (°C): -6.2
- BOILING POINT (°C): 184.4
- FLASH POINT (°C): 70
- IGNITION TEMP. (°C): 615
- VAPOR PRESSURE (mm Hg): 0.67 @ 25°C
- FLAMMABILITY LIMITS: 1.3 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 36,000 @ 18°C
- PERSISTENCE (0 to 2 rating):

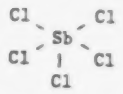
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 2 REACTIVITY: 0
- DOT HAZARD CLASS: Pois. B

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ANTIMONY PENTACHLORIDE
- CAS NO.: 7647189
- SYNONYMS:
- MOLECULAR FORMULA: $SbCl_5$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 2.3
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): 2.8
- BOILING POINT (°C): 79 @ 22 mm Hg
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 1 @ 22.7°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): decomposes
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 0 REACTIVITY: 1
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ARSENIC TRICHLORIDE
- CAS NO.: 7784341
- SYNONYMS: Arsenic chloride, arsenious chloride, arsenous chloride, butter of arsenic
- MOLECULAR FORMULA: $AsCl_3$
- STRUCTURAL FORMULA:

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 2.2
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -8.5
- BOILING POINT (^{o}C): 131.2
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 10 @ 24^{o}C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): decomposes
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 0 REACTIVITY: 0
- DOT HAZARD CLASS: Pois. B

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: BENZENE
- CAS NO.: 71432
- SYNONYMS: Cyclohexatriene, benzol
- MOLECULAR FORMULA: C_6H_6
- STRUCTURAL FORMULA:

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 2.8
- VISCOSITY (centipoises): 0.65 @ 20°C
- SURFACE TENSION (dynes/cm): 28.8 @ 20°C
- MELTING POINT (°C): 5.5
- BOILING POINT (°C): 80.1
- FLASH POINT (°C): -11.1
- IGNITION TEMP. (°C): 560
- VAPOR PRESSURE (mm Hg): 94.9 @ 25°C
- FLAMMABILITY LIMITS: 1.3 - 7.1 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 3,000 @ 25°C
- PERSISTENCE (0 to 2 rating): 1

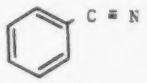
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: BENZONITRILE
- CAS NO.: 100470
- SYNONYMS: Phenyl cyanide, cyanobenzene
- MOLECULAR FORMULA: C_7H_5N
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.0
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises): 1.24 @ 25°C
- SURFACE TENSION (dynes/cm): 39.1 @ 20°C
- MELTING POINT (°C): 12.8
- BOILING POINT (°C): 191
- FLASH POINT (°C): 75
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 1 @ 24.2°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 10,000 @ 100°C
- PERSISTENCE (0 to 2 rating): 1

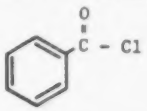
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: BENZOYL CHLORIDE
- CAS NO.: 98884
- SYNONYMS: Benzenecarbonyl chloride
- MOLECULAR FORMULA: C_7H_5ClO
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.2
- VAPOR DENSITY (air=1): 4.9
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -0.5
- BOILING POINT (^{o}C): 197
- FLASH POINT (^{o}C): 73
- IGNITION TEMP. (^{o}C): 585
- VAPOR PRESSURE (mm Hg): 1 @ 32.1^{o}C
- FLAMMABILITY LIMITS (Vol. % in air)
- SOLUBILITY IN WATER (ppm): decomposes
- PERSISTENCE (0 to 2 rating):

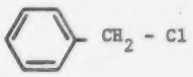
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 2 REACTIVITY: 1
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: BENZYL CHLORIDE
- CAS NO.: 100447
- SYNONYMS:
- MOLECULAR FORMULA: C_7H_7Cl
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.1
- VAPOR DENSITY (air=1): 4.4
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -39
- BOILING POINT (^{o}C): 179
- FLASH POINT (^{o}C): 67.2
- IGNITION TEMP. (^{o}C): 505
- VAPOR PRESSURE (mm Hg): 1.4 @ 25^{o}C
- FLAMMABILITY LIMITS: 1.1- (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 33 @ 25^{o}C
- PERSISTENCE (0 to 2 rating):

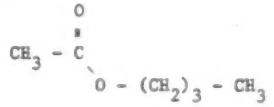
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 2 REACTIVITY: 1
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: BUTYL ACETATE
- SYNONYMS: Acetic acid butyl ester
- CAS NO.: 123864
  iso - 110190
  sec - 105464
  tert - 540895
- MOLECULAR FORMULA: $C_6H_{12}O_2$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 4.0
- VISCOSITY (centipoises): 0.73 @ 20°C
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -74
- BOILING POINT (°C): 126
- FLASH POINT (°C): 22.2
- IGNITION TEMP. (°C): 425
- VAPOR PRESSURE (mm Hg): 15 @ 25°C
- FLAMMABILITY LIMITS: 1.7 - 7.6 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 7,000 @ 20°C
- PERSISTENCE (0 to 2 rating): 2

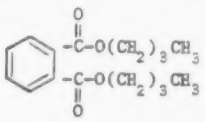
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 1 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: N-BUTYL PHTHALATE
- CAS NO.: 84-74-2
- SYNONYMS: 1,2-Benzenedicarboxylic acid, dibutyl ester, phthalic acid dibutyl ester, dibutyl-o-phthalate, DBP
- MOLECULAR FORMULA: $C_{16}H_{22}O_4$
- STRUCTURAL FORMULA:



278.35

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): d^{20} 1.0465
- VAPOR DENSITY (air=1): 9.6
- VISCOSITY (centipoises): 16.47 @ 25°C
- SURFACE TENSION (dynes/cm): 33.4 @ 20°C
- MELTING POINT (°C): -
- BOILING POINT (°C): 340
- FLASH POINT (°C): 157
- IGNITION TEMP. (°C): 402
- VAPOR PRESSURE (mm Hg): -
- FLAMMABILITY LIMITS: 0.5 (lower limit) (vol. % in air)
- SOLUBILITY IN WATER (ppm): 400 @ 25°C
- PERSISTENCE (0 to 2 rating): 2

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: 0 FLAMMABILITY: 1 REACTIVITY: 0
- DOT HAZARD CLASS: -

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: BUTYLAMINE-
- SYNONYMS: 1-aminobutane
- CAS NO.: 109379
  iso - 78819
  sec - 513495
  sec - 13952846
  tert - 75649
- MOLECULAR FORMULA: $C_4H_{11}N$
- STRUCTURAL FORMULA:

$$CH_3 - (CH_2)_3 - NH_2$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.7
- VAPOR DENSITY (air=1): 2.5
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm): 19.7 @ 41°C
- MELTING POINT (°C): -49
- BOILING POINT (°C): 78
- FLASH POINT (°C): 12.2
- IGNITION TEMP. (°C): 312.2
- VAPOR PRESSURE (mm Hg): 72 @ 20°C
- FLAMMABILITY LIMITS: 1.7 - 9.8 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 1

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: BUTYRIC ACID
- CAS NO.: 107926
- SYNONYMS: Butanoic acid, ethylacetic acid
- MOLECULAR FORMULA: $C_4H_8O_2$
- STRUCTURAL FORMULA:

$$CH_3 - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - OH$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.0
- VAPOR DENSITY (air=1): 3.0
- VISCOSITY (centipoises): 1.81 @ 15°C
- SURFACE TENSION (dynes/cm): 26.8 @ 20°C
- MELTING POINT (°C): -5
- BOILING POINT (°C): 163.5
- FLASH POINT (°C): 71.7
- IGNITION TEMP. (°C): 450
- VAPOR PRESSURE (mm Hg): 0.43 @ 20°C
- FLAMMABILITY LIMITS: 2.0 - 10.0 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 56,000 @ 25°C
- PERSISTENCE (0 to 2 rating): 1

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 2 REACTIVITY: 0
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: CARBON DISULFIDE
- CAS NO.: 75150
- SYNONYMS: Carbon bisulfide, dithiocarbonic anhydride
- MOLECULAR FORMULA: CS_2
- STRUCTURAL FORMULA:

S = C = S

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.3
- VAPOR DENSITY (air=1): 2.6
- VISCOSITY (centipoises): 0.36 @ 20°C
- SURFACE TENSION (dynes/cm): 32.3 @ 20°C
- MELTING POINT (°C): -111
- BOILING POINT (°C): 46.5
- FLASH POINT (°C): -30
- IGNITION TEMP. (°C): 90
- VAPOR PRESSURE (mm Hg): 400 @ 28°C
- FLAMMABILITY LIMITS: 1.3 - 50.0 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 2,200 @ 25°C
- PERSISTENCE (0 to 2 rating): 1

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: CARBON TETRACHLORIDE
- CAS NO.: 56-23-5
- SYNONYMS: Tetrachloromethane, perchloromethane
- MOLECULAR FORMULA: CCl_4
- STRUCTURAL FORMULA:

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.588
- VAPOR DENSITY (air=1): 5.3
- VISCOSITY (centipoises): 0.965 @ 20°C
- SURFACE TENSION (dynes/cm): 26.8 @ 20°C
- MELTING POINT (°C): -23.0
- BOILING POINT (°C): 76.74
- FLASH POINT (°C): none
- IGNITION TEMP. (°C): none
- VAPOR PRESSURE (mm Hg): 91.3 (20°C)
- FLAMMABILITY LIMITS: Nonflammable (vol. % in air)
- SOLUBILITY IN WATER (ppm): 500
- PERSISTENCE (0 to 2 rating): 2

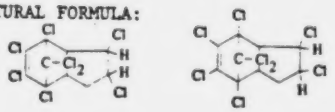
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 0 REACTIVITY: 0
- DOT HAZARD CLASS: ORM

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: CHLORDANE
- CAS NO.: 57749
- SYNONYMS: Toxichlor, chlordan
- MOLECULAR FORMULA: $C_{10}H_6Cl_8$
- STRUCTURAL FORMULA:



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PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.6
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C):
- BOILING POINT (°C): 175
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): $1x10^{-5}$ at 25°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): insoluble
- PERSISTENCE (0 to 2 rating):

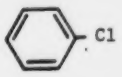
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: X
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS: Comb. L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: CHLOROBENZENE
- CAS NO.: 108907
- SYNONYMS: Monochlorobenzen, benzen chloride
- MOLECULAR FORMULA: C_6H_5Cl
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.1
- VAPOR DENSITY (air=1): 3.9
- VISCOSITY (centipoises): 0.8 @ 20°C
- SURFACE TENSION (dynes/cm): 33.63 @ 20°C
- MELTING POINT (°C): -45
- BOILING POINT (°C): 132
- FLASH POINT (°C): 28.9
- IGNITION TEMP. (°C): 640
- VAPOR PRESSURE (mm Hg): 12.1 @ 25°C
- FLAMMABILITY LIMITS: 1.3 - 7.1 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 488 @ 25°C
- PERSISTENCE (0 to 2 rating):

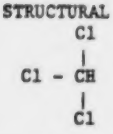
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: CHLOROFORM
- CAS NO.: 67663
- SYNONYMS: Trichloromethane
- MOLECULAR FORMULA: $CHCl_3$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.5
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises): 0.6 @ 20°C
- SURFACE TENSION (dynes/cm): 27.1 @ 20°C
- MELTING POINT (°C): -63
- BOILING POINT (°C): 62
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 200 @ 25°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 2,000 @ 25°C
- PERSISTENCE (0 to 2 rating): 1

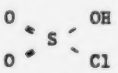
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 0 REACTIVITY: 0
- DOT HAZARD CLASS: ORM

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: CHLOROSULFONIC ACID
- CAS NO.: 7790945
- SYNONYMS: Sulfuric chlorohydrin
- MOLECULAR FORMULA: $ClHO_3S$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.8
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -80
- BOILING POINT (°C): 151.5
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 1 @ 32°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): decomposes
- PERSISTENCE (0 to 2 rating):

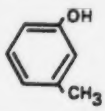
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- **NAME:** CRESOL
- **CAS NO.:** 1319773
- **SYNONYMS:** Cresylic acid (m- CAS No. 108394); hydroxytoluene (o- CAS No. 95487) p- CAS No. 106445
- **MOLECULAR FORMULA:** C_7H_8O
- **STRUCTURAL FORMULA:**



(m-Cresol)

PHYSICAL/CHEMICAL PROPERTIES

- **SPECIFIC GRAVITY (water=1):** 1.1 (o-) 1.0 (m- or p-)
- **VAPOR DENSITY (air=1):** 3.7 (o-)
- **VISCOSITY (centipoises):** 20.8 @ 20°C
- **SURFACE TENSION (dynes/cm):**
- **MELTING POINT (°C):** 31 (o-) 11 (m-) 35 (p-)
- **BOILING POINT (°C):** 191 (o-) 202 (m- and p-)
- **FLASH POINT (°C):** 81.1 (o-) 94.4 (m- and p-)
- **IGNITION TEMP. (°C):** 598.9 (o-) 558.9 (m- and p-)
- **VAPOR PRESSURE (mm Hg):**
- **FLAMMABILITY LIMITS: (Vol. % in air)** 1.4 @ 148.9 (o-) 1.1 @ 150 (m- and p-)
- **SOLUBILITY IN WATER (ppm):** 20,000
- **PERSISTENCE (0 to 2 rating):**

HAZARD CLASSIFICATIONS

- **EPA REPORTABLE QUANTITY CATEGORY:** C
- **NFPA HAZARD RATING:** **HEALTH:** 3 3 **FLAMMABILITY:** 2 1 **REACTIVITY:** 0 (o-) 0 (m- and p-)
- **DOT HAZARD CLASS:** Pois. B

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: CROTONALDEHYDE
- CAS NO.: 4170-30-3
- SYNONYMS: trans-2-butenal, crotonic aldehyde, β-methylacrolein, propylene aldehyde
- MOLECULAR FORMULA: C_4H_6O
- STRUCTURAL FORMULA:

$$CH_3CH = CHCH \overset{\overset{O}{\|}}{}$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.8531
- VAPOR DENSITY (air=1): 2.41
- VISCOSITY (centipoises): -
- SURFACE TENSION (dynes/cm): -
- MELTING POINT (°C): -76.5
- BOILING POINT (°C): 104
- FLASH POINT (°C): 13 (open cup)
- IGNITION TEMP. (°C): 232
- VAPOR PRESSURE (mm Hg): 30 @ 20°C
- FLAMMABILITY LIMITS: 2.95-15.5 (vol. % in air)
- SOLUBILITY IN WATER (ppm): 181,000 @ 20°C
- PERSISTENCE (0 to 2 rating): 0

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 3 REACTIVITY: 2
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: CYANOGEN CHLORIDE
- CAS NO.: 506774
- SYNONYMS:
- MOLECULAR FORMULA: CClN
- STRUCTURAL FORMULA:

Cl - C ≡ N

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.2
- VAPOR DENSITY (air=1): 2.1
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -6
- BOILING POINT (^{o}C): 13.8
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 40 @ -37.5^{o}C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 2,500 @ 25^{o}C
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: A
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS: Pois. A

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: CYCLOHEXANE
- CAS NO.: 110827
- SYNONYMS: Hexahydrobenzene, hexamethylene, hexanaphthene
- MOLECULAR FORMULA: C_6H_{12}
- STRUCTURAL FORMULA:

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.8
- VAPOR DENSITY (air=1): 2.9
- VISCOSITY (centipoises): 0.7 @ 20°C
- SURFACE TENSION (dynes/cm): 25.5 @ 20°C
- MELTING POINT (°C): 6.1
- BOILING POINT (°C): 81
- FLASH POINT (°C): -20
- IGNITION TEMP. (°C): 245
- VAPOR PRESSURE (mm Hg): 98.1 @ 25°C
- FLAMMABILITY LIMITS: 1.3 - 8.0 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 45 @ 25°C
- PERSISTENCE (0 to 2 rating): 1

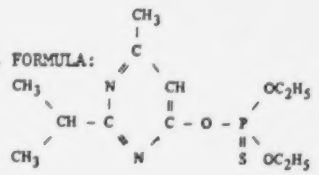
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 1 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: DIAZINON
- CAS NO.: 333415
- SYNONYMS: Dipofene, diazitol, Basudin, Spectracide
- MOLECULAR FORMULA: $C_{12}H_{21}N_2O_3PS$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.1
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C):
- BOILING POINT (^{o}C): 83 @ 0.002 mm Hg
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): $1x10^{-4}$ @ 20^{o}C
- FLAMMABILITY LIMITS (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 40 @ 25^{o}C
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: X
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS: ORM

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: O-DICHLOROBENZENE
- CAS NO.: 95-50-1
- SYNONYMS: o-dichlorobenzol
- MOLECULAR FORMULA: $C_6H_4Cl_2$
- STRUCTURAL FORMULA:

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.309 $\frac{20}{4}$ °C
- VAPOR DENSITY (air=1): 5.07
- VISCOSITY (centipoises): 1.324 @ 25°C
- SURFACE TENSION (dynes/cm): 26.84 @ 20°C
- MELTING POINT (°C): -17.03
- BOILING POINT (°C): 180.5
- FLASH POINT (°C): 66 (closed cup)
- IGNITION TEMP. (°C): 648
- VAPOR PRESSURE (mm Hg): -
- FLAMMABILITY LIMITS: 2.2-9.2 (vol. % in air)
- SOLUBILITY IN WATER (ppm): insoluble
- PERSISTENCE (0 to 2 rating): 2

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 2 REACTIVITY: 0
- DOT HAZARD CLASS: ORM

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: DICHLOROPROPENE-DICHLOROPROPANE MIXTURE
- CAS NO.: 8003-19-8
- SYNONYMS: D-D mixture, Vidden D, Ent 8,420 (*1,3-Dichloro-1-propene + 1,2-Dichloropropane mixture).
- MOLECULAR FORMULA:

  $C_3H_4Cl_2$

  +

  $C_3H_6Cl_2$

- STRUCTURAL FORMULA:

  $ClCH_2-CH = CHCl$ (1)

  +

  $CH_3-CHCl-CH_2Cl$ (2)

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1):
  1.233 (1)
  1.158 (2)
- VAPOR DENSITY (air=1):
  3.83 (1)
  3.90 (2)
- VISCOSITY (centipoises): -
- SURFACE TENSION (dynes/cm):
  28.9 @ 20°C (2)
- MELTING POINT (°C): -70°C (1)
  -80°C (2)
- BOILING POINT (°C): 108° (1)
  96.4° (2)
- FLASH POINT (°C): 35 (1) (open cup)
  16.1 (2) (open cup)
- IGNITION TEMP. (°C): 557 (2)
- VAPOR PRESSURE (mm Hg): 40 @ 19.4°C (2)
- FLAMMABILITY LIMITS (vol. % in air): 5.3-14.5 (1)
  3.4-14.5% (2)
- SOLUBILITY IN WATER (ppm): sl. s. (1)
  2.700 @ 20°C (2)
- PERSISTENCE (0 to 2 rating): -

HAZARD CLASSIFICATIONS

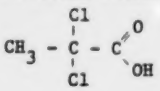
- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: Cor.

*Note: According to Chem Abstracts, "DD" is the mixture of these two isomers. According to the Merck Index (9th Ed.), "DD" is the mixture of two dichloropropene isomers. According to the Condensed Chemical Dictionary (8th Ed.), "DD" is the mixture of three dichloropropene isomers and related C_3 chlorinated compounds.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: 2,2-DICHLOROPROPIONIC ACID
- CAS NO.: 75990
- SYNONYMS: Dalapon
- MOLECULAR FORMULA: $C_3H_4Cl_2O_2$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.4
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C):
- BOILING POINT (°C): 185 - 190
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg):
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 450,000 @ 25°C
- PERSISTENCE (0 to 2 rating):

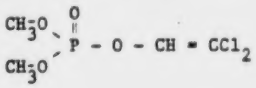
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: DICHLORVOS
- CAS NO.: 62737
- SYNONYMS: 2,2-Dichlorovinyl dimethyl phosphate, Vapona
- MOLECULAR FORMULA: $C_4H_7Cl_2O_4P$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.4
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C):
- BOILING POINT (^{o}C): 140 @ 200 mm Hg
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 3.2×10^{-2}
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 10,000 @ $20^{o}C$
- PERSISTENCE (0 to 2 rating):

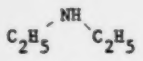
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: A
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: DIETHYLAMINE
- CAS NO.: 109897
- SYNONYMS:
- MOLECULAR FORMULA: $C_4H_{11}N$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.7
- VAPOR DENSITY (air=1): 2.5
- VISCOSITY (centipoises): 0.35 @ 25°C
- SURFACE TENSION (dynes/cm): 16.4 @ 56°C
- MELTING POINT (°C): -50
- BOILING POINT (°C): 55
- FLASH POINT (°C): -26
- IGNITION TEMP. (°C): 312.2
- VAPOR PRESSURE (mm Hg): 247.1 @ 25°C
- FLAMMABILITY LIMITS: 1.8 - (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 0

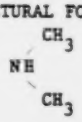
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: DIMETHYLAMINE
- CAS NO.: 124403
- SYNONYMS:
- MOLECULAR FORMULA: C_2H_7N
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.7
- VAPOR DENSITY (air=1): 1.6
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -96
- BOILING POINT (^{o}C): 7.4
- FLASH POINT (^{o}C): -7
- IGNITION TEMP. (^{o}C): 400
- VAPOR PRESSURE (mm Hg): 1277 @ 20^{o}C
- FLAMMABILITY LIMITS: 2.8 - 14.4 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 237,000
- PERSISTENCE (0 to 2 rating): 1

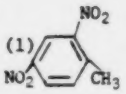
HAZARD CLASSIFICATIONS

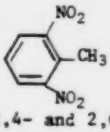
- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 4 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: DINITROTOLUENE
- CAS NO.: 25321-14-6
- SYNONYMS: DNT
- MOLECULAR FORMULA: $C_7H_6N_2O_4$
- STRUCTURAL FORMULA:

(1)  (2,4-DNT)

(2)  (2,6-DNT)

(Commercial DNT is a 80/20 mixture of 2,4- and 2,6-DNT)

PHYSICAL/CHEMICAL PROPERTIES (2)

- SPECIFIC GRAVITY (water=1): 1.28(1)
- VAPOR DENSITY (air=1): 6.27
- VISCOSITY (centipoises): -
- SURFACE TENSION (dynes/cm): -
- MELTING POINT (°C): 66(1)
- BOILING POINT (°C): 300
- FLASH POINT (°C): 207
- IGNITION TEMP. (°C): -
- VAPOR PRESSURE (mm Hg): -
- FLAMMABILITY LIMITS: - (vol. % in air)
- SOLUBILITY IN WATER (ppm): 220 @ 22°C
- PERSISTENCE (0 to 2 rating): -

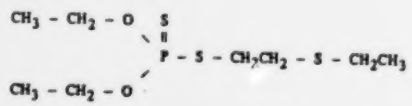
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 1 REACTIVITY: 3
- DOT HAZARD CLASS: -

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: DISULFOTON
- CAS NO.: 298044
- SYNONYMS: Di-syston
- MOLECULAR FORMULA: $C_8H_{19}O_2PS_3$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.1
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C):
- BOILING POINT (^{o}C): 62 @ 0.01 mm Hg
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 1.8×10^{-4} @ 20^{o}C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 25
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: A
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ETHION
- CAS NO.: 563122
- SYNONYMS: Nialate, ethyl methylene phosphorodithioate
- MOLECULAR FORMULA: $C_9H_{22}O_4P_2S_4$
- STRUCTURAL FORMULA:

$$(C_2H_5O)_2\overset{S}{\overset{\|}{P}} - S - CH_2 - S - \overset{S}{\overset{\|}{P}}(OC_2H_5)_2$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.2
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -13
- BOILING POINT (°C):
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 1.5×10^{-6} @ 25°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 2 @ 20°C
- PERSISTENCE (0 to 2 rating): 1

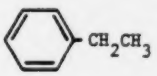
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: A
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ETHYLBENZENE
- CAS NO.: 100414
- SYNONYMS: Phenylethane
- MOLECULAR FORMULA: C_8H_{10}
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 3.7
- VISCOSITY (centipoises): 0.7 @ 17°C
- SURFACE TENSION (dynes/cm): 29.2 @ 20°C
- MELTING POINT (°C): -95
- BOILING POINT (°C): 136
- FLASH POINT (°C): 15
- IGNITION TEMP. (°C): 432.2
- VAPOR PRESSURE (mm Hg): 9.6 @ 25°C
- FLAMMABILITY LIMITS: 1.0 - 6.7 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 14 @ 25°C
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ETHYLENEDIAMINE
- CAS NO.: 107153
- SYNONYMS: 1,2-diaminoethane
- MOLECULAR FORMULA: $C_2H_8N_2$
- STRUCTURAL FORMULA:

$$H_2N - CH_2 - CH_2 - NH_2$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 2.1
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): 8.5
- BOILING POINT (^{o}C): 116.5
- FLASH POINT (^{o}C): 65.6
- IGNITION TEMP. (^{o}C): 385
- VAPOR PRESSURE (mm Hg): 13.04 @ 25^{o}C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating):

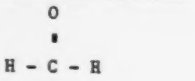
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 2 REACTIVITY: 0
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: FORMALDEHYDE
- CAS NO.: 50000
- SYNONYMS: Formic aldehyde, methanal, formalin
- MOLECULAR FORMULA: CH_2O
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.0
- VAPOR DENSITY (air=1): 1.1
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm): 58.2 @ 20°C
- MELTING POINT (°C): -92
- BOILING POINT (°C): 19.5
- FLASH POINT (°C): 85 (37% solution with 0.5 methyl alcohol)
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 1946.7 @ 25°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 550,000
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 2 FLAMMABILITY: 2 4 REACTIVITY: 0 (solution) 0 (gas)
- DOT HAZARD CLASS: ORM

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: FORMIC ACID
- CAS NO.: 64186
- SYNONYMS: Methanoic acid
- MOLECULAR FORMULA: CH_2O_2
- STRUCTURAL FORMULA:

O = CH - OH

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.2
- VAPOR DENSITY (air=1): 1.6
- VISCOSITY (centipoises): 18 @ 20°C
- SURFACE TENSION (dynes/cm): 37.6 @ 20°C
- MELTING POINT (°C): 8.4
- BOILING POINT (°C): 101
- FLASH POINT (°C): 68.9
- IGNITION TEMP. (°C): 601.1
- VAPOR PRESSURE (mm Hg): 42.4 @ 25°C
- FLAMMABILITY LIMITS: 18-57 (vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 0

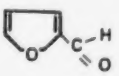
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 2 REACTIVITY: 0
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: FURFURAL
- CAS NO.: 98011
- SYNONYMS: 2-furaldehyde, pyromucic aldehyde
- MOLECULAR FORMULA: $C_5H_4O_2$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.2
- VAPOR DENSITY (air=1): 3.3
- VISCOSITY (centipoises): 1.5 @ 25°C
- SURFACE TENSION (dynes/cm): 43.5 @ 20°C
- MELTING POINT (°C): -36
- BOILING POINT (°C): 162
- FLASH POINT (°C): 60
- IGNITION TEMP. (°C): 315.6
- VAPOR PRESSURE (mm Hg): 2.1 @ 25°C
- FLAMMABILITY LIMITS: 2.1 - 19.3 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 83,000 @ 20°C
- PERSISTENCE (0 to 2 rating): 0

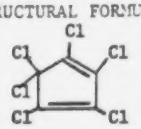
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 1 FLAMMABILITY: 2 REACTIVITY: 1
- DOT HAZARD CLASS: Comb. L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: HEXACHLOROCYCLOPENTADIENE
- CAS NO.: 77-47-4
- SYNONYMS: Perchlorocyclopentadiene, C-56, 1,3-cyclopentadiene, 1,2,3,4,5,5-hexachloro-
- MOLECULAR FORMULA: C_5Cl_6
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.717
- VAPOR DENSITY (air=1): 9.42
- VISCOSITY (centipoises): -
- SURFACE TENSION (dynes/cm): -
- MELTING POINT (°C): 9.6
- BOILING POINT (°C): 239
- FLASH POINT (°C): none
- IGNITION TEMP. (°C): none
- VAPOR PRESSURE (mm Hg): -
- FLAMMABILITY LIMITS: Nonflammable (vol. % in air)
- SOLUBILITY IN WATER (ppm): -
- PERSISTENCE (0 to 2 rating): 2

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: X
- NFPA HAZARD RATING: HEALTH: - FLAMMABILITY: - REACTIVITY: -
- DOT HAZARD CLASS: -

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: HYDROCHLORIC ACID
- CAS NO.: 7647010
- SYNONYMS: Hydrogen chloride, muriatic acid
- MOLECULAR FORMULA: HCl
- STRUCTURAL FORMULA:

$H^+ \ Cl^-$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.1 (20% solution)
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises): 25.4 @ 20°C
- SURFACE TENSION (dynes/cm : 70 @ 20°C
- MELTING POINT (°C): -115 (20% solution, -62)
- BOILING POINT (°C): -85 (20% solution, 108.6)
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 1 @ 145.8
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 832,000 @ 25°C
- PERSISTENCE (0 to 2 rating): 2

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 0 REACTIVITY: 0
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: HYDROFLUORIC ACID
- CAS NO.: 764393
- SYNONYMS: Fluohydric acid
- MOLECULAR FORMULA: HF
- STRUCTURAL FORMULA: H^{+} F^{-}

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.96 (70% solution, 1.2)
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -83.6 (70% solution, -75)
- BOILING POINT (°C): 19.5 (70% solution, 65)
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 400 @ 2.5°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: HYDROGEN CYANIDE
- CAS NO.: 74908
- SYNONYMS: Hydrocyanic acid
- MOLECULAR FORMULA: HCN
- STRUCTURAL FORMULA:

HC ≡ N

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.7 as liquid
- VAPOR DENSITY (air=1): 0.9
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -14
- BOILING POINT (^{o}C): 25.6
- FLASH POINT (^{o}C): -18
- IGNITION TEMP. (^{o}C): 537.8
- VAPOR PRESSURE (mm Hg): 264.4 @ 0^{o}C
- FLAMMABILITY LIMITS: 5.6 - 40.0 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: A
- NFPA HAZARD RATING: HEALTH: 4 FLAMMABILITY: 4 REACTIVITY: 2
- DOT HAZARD CLASS: Pois. A (5% or more hydrocyanic acid)
  Pois. B (less than 5% hydrocyanic acid)

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ISOPRENE
- CAS NO.: 78795
- SYNONYMS: 2-methyl-1,3-butadiene
- MOLECULAR FORMULA: C_5H_8
- STRUCTURAL FORMULA:

$$CH_2 = \overset{\displaystyle CH_3}{\overset{|}{C}} - CH = CH_2$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.7
- VAPOR DENSITY (air=1): 2.35
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -146
- BOILING POINT (^{o}C): 34
- FLASH POINT (^{o}C): -65
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 493 @ 20^{o}C
- FLAMMABILITY LIMITS: 2.9 - (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 100
- PERSISTENCE (0 to 2 rating): 0

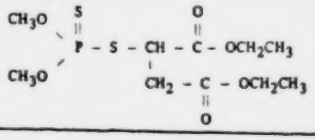
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 4 REACTIVITY: 1
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: MALATHION
- CAS NO.: 121755
- SYNONYMS: Phosphothion
- MOLECULAR FORMULA: $C_{10}H_{19}O_6PS_2$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.2
- VAPOR DENSITY (air=1): 2.3
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): 2.9
- BOILING POINT (^{o}C): 156
- FLASH POINT (^{o}C): -53.9
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 4×10^{-5} @ 30°C
- FLAMMABILITY LIMITS (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 145 @ 25°C
- PERSISTENCE (0 to 2 rating): 0

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: A
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS: ORM

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: METHYL MERCAPTAN
- CAS NO.: 74931
- SYNONYMS: Methanethiol, mercaptomethane, methyl sulfhydrate, thiomethyl alcohol
- MOLECULAR FORMULA: CH_4S
- STRUCTURAL FORMULA:

$CH_3 - S - H$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 1.7
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -123
- BOILING POINT (^{o}C): 6.8
- FLASH POINT (^{o}C): <0
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 760 @ 6.8^{o}C
- FLAMMABILITY LIMITS: 3.9 - 21.8 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 24,000 @ 15^{o}C
- PERSISTENCE (0 to 2 rating):

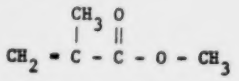
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 4 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: METHYL METHACRYLATE
- CAS NO.: 80626
- SYNONYMS: Methacrylic acid methyl ester, methyl-2-methyl-2-propenate
- MOLECULAR FORMULA: $C_5H_8O_2$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.94
- VAPOR DENSITY (air=1): 3.45
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -48
- BOILING POINT (°C): 101
- FLASH POINT (°C): 10 @ 0°C
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 30 @ 25.5°C
- FLAMMABILITY LIMITS: 1.7 - 8.2 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 1,600 @ 20°C
- PERSISTENCE (0 to 2 rating): 1

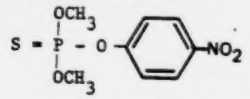
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 2
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: METHYL PARATHION
- CAS NO.: 298000
- SYNONYMS: Nitrox-80
- MOLECULAR FORMULA: $C_8H_{10}NO_5PS$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.3
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): 35 - 36
- BOILING POINT (°C): decomposes
- FLASH POINT (°C): 46.1 (open cup)
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 0.97 @ 20°C
- FLAMMABILITY LIMITS (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 50 @ 25°C
- PERSISTENCE (0 to 2 rating): 1

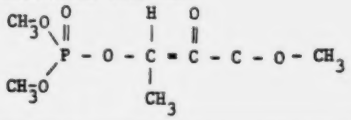
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: 4 / 4 FLAMMABILITY: 1 / 3 REACTIVITY: 2 (solid) / 2 (Xylene solution)
- DOT HAZARD CLASS: Pois. B

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: MEVINPHOS
- CAS NO.: 7786347
- SYNONYMS: Phosdrin
- MOLECULAR FORMULA: $C_7H_{13}O_6P$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.25
- VAPOR DENSITY (air=1): 3.2
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C):
- BOILING POINT (°C): 99 - 103 @ 0.03 mm Hg
- FLASH POINT (°C): 49
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 2.9×10^{-3} @ 21°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 1

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: X
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: MONOETHYLAMINE
- CAS NO.: 75047
- SYNONYMS: Ethylamine, aminoethane
- MOLECULAR FORMULA: C_2H_7N
- STRUCTURAL FORMULA:

$C_2H_5 - NH_2$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.8
- VAPOR DENSITY (air=1): 1.6
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -80.6
- BOILING POINT (^{o}C): 16.6
- FLASH POINT (^{o}C): <21.1
- IGNITION TEMP. (^{o}C): 385
- VAPOR PRESSURE (mm Hg): 1094.2 @ 25^{o}C
- FLAMMABILITY LIMITS: 2.5 - 14.0 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 0

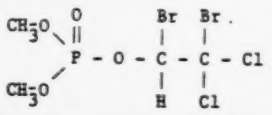
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 4 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: NALED
- CAS NO.: 300765
- SYNONYMS: Dibrom
- MOLECULAR FORMULA: $C_4H_7Br_2Cl_2O_4P$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.96
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): 27
- BOILING POINT (°C): 110 (0.5 mm Hg)
- FLASH POINT (°C): 54
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 2×10^{-4} @ 20°C
- FLAMMABILITY LIMITS (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 500
- PERSISTENCE (0 to 2 rating):

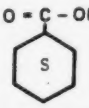
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: A
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: NAPHTHENIC ACID*
- CAS NO.: 1338245
- SYNONYMS: Cyclohexanecarboxylic acid, hexahydrobenzoic acid
- MOLECULAR FORMULA: $C_7H_{12}O_2$
- STRUCTURAL FORMULA:



*contains other saturated fatty acids

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.03
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): 30
- BOILING POINT (^{o}C): 233
- FLASH POINT (^{o}C): 149
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 46 @ 38^{o}C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 2,010 @ 25^{o}C
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: NITRIC ACID
- CAS NO.: 7697372
- SYNONYMS: Aqua fortis
- MOLECULAR FORMULA: HNO_3
- STRUCTURAL FORMULA:

$$H^+ \; NO_3^-$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.5
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT ($^\circ$C): -42
- BOILING POINT ($^\circ$C): 86
- FLASH POINT ($^\circ$C):
- IGNITION TEMP. ($^\circ$C):
- VAPOR PRESSURE (mm Hg): 7.1 @ 20°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating):

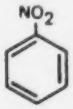
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 0 REACTIVITY: 0
- DOT HAZARD CLASS: Oxy. M

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: NITROBENZENE
- CAS NO.: 98953
- SYNONYMS: Nitrobenzol, oil of mirbane
- MOLECULAR FORMULA: $C_6H_5NO_2$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.2
- VAPOR DENSITY (air=1): 4.3
- VISCOSITY (centipoises): 2.03 @ 20°C
- SURFACE TENSION (dynes/cm): 43.9 @ 20°C
- MELTING POINT (°C): 6
- BOILING POINT (°C): 211
- FLASH POINT (°C): 87.8
- IGNITION TEMP. (°C): 482.2
- VAPOR PRESSURE (mm Hg): 0.284 @ 25°C
- FLAMMABILITY LIMITS: 1.8 - (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 1,900 @ 20°C
- PERSISTENCE (0 to 2 rating): 2

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 2 REACTIVITY: 0
- DOT HAZARD CLASS: Pois. B

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: NITROGEN DIOXIDE
- CAS NO.: 10102440
- SYNONYMS: Nitrogen tetroxide
- MOLECULAR FORMULA: $NO_2 \rightleftharpoons N_2O_4$
- STRUCTURAL FORMULA:

O = N - O

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.45
- VAPOR DENSITY (air=1): 1.59
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -9.3
- BOILING POINT (^{o}C): 21.3
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 760 @ 21^{o}C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): decomposes
- PERSISTENCE (0 to 2 rating):

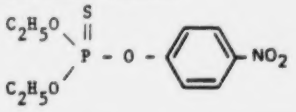
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 0 REACTIVITY: 0
- DOT HAZARD CLASS: Pois. A

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: PARATHION
- CAS NO.: 56382
- SYNONYMS: DNTP, Niran
- MOLECULAR FORMULA: $C_{10}H_{14}NO_5PS$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.3
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): 6
- BOILING POINT (°C): 375
- FLASH POINT (°C): 132
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 0.03 @ 24°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 20
- PERSISTENCE (0 to 2 rating): 1

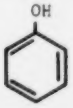
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: X
- NFPA HAZARD RATING: HEALTH: 4 FLAMMABILITY: 1 REACTIVITY: 2
- DOT HAZARD CLASS: Pois. B

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: PHENOL
- CAS NO.: 108952
- SYNONYMS: Carbolic acid, phenyl hydroxide, hydroxybenzene, oxybenzene
- MOLECULAR FORMULA: C_6H_6O
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.1
- VAPOR DENSITY (air=1): 3.2
- VISCOSITY (centipoises): 3.49 @ 50°C
- SURFACE TENSION (dynes/cm): 40.9 @ 20°C
- MELTING POINT (°C): 41
- BOILING POINT (°C): 182
- FLASH POINT (°C): 79
- IGNITION TEMP. (°C): 715
- VAPOR PRESSURE (mm Hg): 0.530 @ 25°C
- FLAMMABILITY LIMITS: 1.5 - (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 6,700 @ 25°C
- PERSISTENCE (0 to 2 rating): 2

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 2 REACTIVITY: 0
- DOT HAZARD CLASS: Pois. B

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: PHOSGENE
- CAS NO.: 75445
- SYNONYMS: Diphosgene, carbonyl chloride, chloroformyl chloride
- MOLECULAR FORMULA: CCl_2O
- STRUCTURAL FORMULA:

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.4
- VAPOR DENSITY (air=1): 3.4
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -118
- BOILING POINT (°C): 8.2
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 1200 @ 20°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): decomposes
- PERSISTENCE (0 to 2 rating): 0

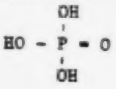
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 4 FLAMMABILITY: 0 REACTIVITY: 0
- DOT HAZARD CLASS: Pois. A

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: PHOSPHORIC ACID
- CAS NO.: 7664382
- SYNONYMS:
- MOLECULAR FORMULA: H_3O_4P
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.9
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): 42.3
- BOILING POINT (^{o}C): decomposes at 213
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg):
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 2

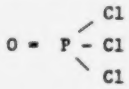
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 0 REACTIVITY: 0
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: PHOSPHORUS OXYCHLORIDE
- CAS NO.: 10025873
- SYNONYMS: Phosphoryl chloride, phosphorus chloride
- MOLECULAR FORMULA: Cl_3OP
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.7
- VAPOR DENSITY (air=1): 6.8
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): 1.25
- BOILING POINT (°C): 107
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 28 @ 20°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): decomposes
- PERSISTENCE (0 to 2 rating):

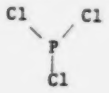
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 0 REACTIVITY: 2
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: PHOSPHORUS TRICHLORIDE
- CAS NO.: 7719122
- SYNONYMS: Phosphorus chloride
- MOLECULAR FORMULA: Cl_3P
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.6
- VAPOR DENSITY (air=1): 4.8
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -112
- BOILING POINT (^{o}C): 76
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 100 @ 21^{o}C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): decomposes
- PERSISTENCE (0 to 2 rating): 0

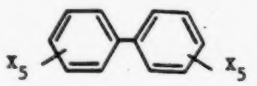
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 0 REACTIVITY: 2
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: POLYCHLORINATED BIPHENYLS
- CAS NO.: 1336363
- SYNONYMS: PCB, aroclor, polychlorinated biphenyls
- MOLECULAR FORMULA: $C_{12}H_nCl_{10-n}$
- STRUCTURAL FORMULA:



X = Cl or H

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.2-1.5
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C):
- BOILING POINT (°C): 325-366
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): <1 @ 25°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 0.3-0.5
- PERSISTENCE (0 to 2 rating): 2

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: A
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: PROPIONIC ACID
- CAS NO.: 79094
- SYNONYMS:
- MOLECULAR FORMULA: $C_3H_6O_2$
- STRUCTURAL FORMULA:

$$CH_3 - CH_2 - \overset{O}{\overset{\|}{C}} - OH$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.0
- VAPOR DENSITY (air=1): 2.5
- VISCOSITY (centipoises): 1.1 @ 20°C
- SURFACE TENSION (dynes/cm): 26.7 @ 20°C
- MELTING POINT (°C): -21
- BOILING POINT (°C): 141
- FLASH POINT (°C): 54.4
- IGNITION TEMP. (°C): 512.8
- VAPOR PRESSURE (mm Hg): 4.5 @ 25°C
- FLAMMABILITY LIMITS: 2.9 - —— (vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 0

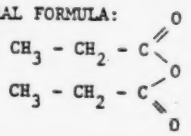
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 2 REACTIVITY: 0
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: PROPIONIC ANHYDRIDE
- CAS NO.: 123626
- SYNONYMS: Propanoic anhydride, methylacetic anhydride
- MOLECULAR FORMULA: $C_6H_{10}O_3$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.0
- VAPOR DENSITY (air=1): 4.5
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -45
- BOILING POINT (°C): 168
- FLASH POINT (°C): 73.9
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 1 @ 26°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): decomposes
- PERSISTENCE (0 to 2 rating): 1

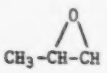
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 2 REACTIVITY: 1
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: PROPYLENE OXIDE
- CAS NO.: 75-56-9
- SYNONYMS: Propene oxide, 1,2-epoxypropane
- MOLECULAR FORMULA: C_3H_6O
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.831
- VAPOR DENSITY (air=1): 2.00
- VISCOSITY (centipoises): 0.327 @ 20°C
- SURFACE TENSION (dynes/cm): -
- MELTING POINT (°C): -104
- BOILING POINT (°C): 35
- FLASH POINT (°C): -37 (open cup)
- IGNITION TEMP. (°C): 449
- VAPOR PRESSURE (mm Hg): 4.45 @ 20°C
- FLAMMABILITY LIMITS: 2.1-21.5 (vol. % in air)
- SOLUBILITY IN WATER (ppm): 330,000 @ 30°C
- PERSISTENCE (0 to 2 rating): 0

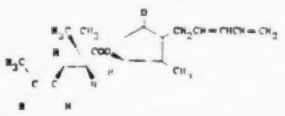
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 4 REACTIVITY: 2
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: PYRETHRINS
- CAS NO.: 121299 (Pyrethrin I) 121211 (Pyrethrin II)
- SYNONYMS: Pyrethrin I, Pyrethrin II
- MOLECULAR FORMULA: $C_{21}H_{28}O_3$ and $C_{22}H_{28}O_5$
- STRUCTURAL FORMULA:



(Pyrethrin I)

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.5
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): 0
- BOILING POINT (°C): decomposes
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg):
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 1
- PERSISTENCE (0 to 2 rating):

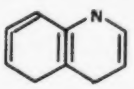
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: QUINOLINE
- CAS NO.: 91225
- SYNONYMS: 1-benzazine, benzo(b)pyridine, leuocoline, chinoleine, leucol
- MOLECULAR FORMULA: C_9H_7N
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.1
- VAPOR DENSITY (air=1): 4.5
- VISCOSITY (centipoises): 0.6 @ 17°C
- SURFACE TENSION (dynes/cm): 17 @ 28.5°C
- MELTING POINT (°C): -15
- BOILING POINT (°C): 237.7
- FLASH POINT (°C):
- IGNITION TEMP. (°C): 480
- VAPOR PRESSURE (mm Hg): 1 @ 59.7
- FLAMMABILITY LIMITS: 1.2 - (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 60,000 @ 25°C
- PERSISTENCE (0 to 2 rating): 0

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 1 REACTIVITY: 0
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: SODIUM HYPOCHLORITE
- CAS NO.: 7681529, 10022705
- SYNONYMS: Bleach
- MOLECULAR FORMULA: NaClO (usually in solution; dihydrate is solid)
- STRUCTURAL FORMULA:

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.0
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): 57.5 (dihydrate)
- BOILING POINT (°C):
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg):
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 293,000 @ 0°C
- PERSISTENCE (0 to 2 rating):

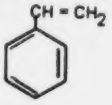
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: STYRENE
- CAS NO.: 100425
- SYNONYMS: Vinylbenzene, phenylethylene, styrol, styrolene, cinnamene, cinnamol
- MOLECULAR FORMULA: C_8H_8
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 3.6
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm): 32.1 @ 19°C
- MELTING POINT (°C): 31
- BOILING POINT (°C): 146
- FLASH POINT (°C): 32
- IGNITION TEMP. (°C): 490
- VAPOR PRESSURE (mm Hg): 6.05 @ 25°C
- FLAMMABILITY LIMITS: 1.1 - 6.1 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 320 @ 25°C
- PERSISTENCE (0 to 2 rating): 1

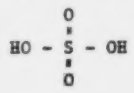
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 2
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: SULFURIC ACID
- CAS NO.: 7664937
- SYNONYMS: Oil of vitriol, oleum
- MOLECULAR FORMULA: H_2O_4S
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.8
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises): 26.9 @ 15
- SURFACE TENSION (dynes/cm): 55.1 @ 20°C
- MELTING POINT (°C): 10
- BOILING POINT (°C): 290
- FLASH POINT (°C):
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 3×10^{-4}
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 2

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 0 REACTIVITY: 2
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: SULFUR MONOCHLORIDE
- CAS NO.: 12771083
- SYNONYMS: Sulfur chloride
- MOLECULAR FORMULA: Cl_2S_2
- STRUCTURAL FORMULA:

Cl - S = S - Cl

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.7
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -82
- BOILING POINT (^{o}C): 138
- FLASH POINT (^{o}C): 118
- IGNITION TEMP. (^{o}C): 239
- VAPOR PRESSURE (mm Hg): 10 @ 27.5^{o}C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): decomposes
- PERSISTENCE (0 to 2 rating):

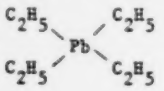
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 1 REACTIVITY: 1
- DOT HAZARD CLASS: Cor.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: TETRAETHYL LEAD
- CAS NO.: 78002
- SYNONYMS: Lead tetraethyl, TEL
- MOLECULAR FORMULA: $C_8H_{20}Pb$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.7
- VAPOR DENSITY (air=1): 8.6
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (°C): -137
- BOILING POINT (°C): decomposes above 230
- FLASH POINT (°C): 93.3
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg): 1 @ 28.4°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 30 @ 25°C
- PERSISTENCE (0 to 2 rating): 1

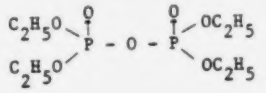
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: B
- NFPA HAZARD RATING: HEALTH: 3 FLAMMABILITY: 2 REACTIVITY: 3
- DOT HAZARD CLASS: Pois. B

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: TETRAETHYL PYROPHOSPHATE
- CAS NO.: 107493
- SYNONYMS: TEPP
- MOLECULAR FORMULA: $C_8H_{10}O_7P_2$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1):
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C):
- BOILING POINT (^{o}C):
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg):
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): miscible
- PERSISTENCE (0 to 2 rating): 1

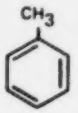
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: TOLUENE
- CAS NO.: 108883
- SYNONYMS: Toluol, methylbenzene, phenylmethane
- MOLECULAR FORMULA: C_7H_8
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 3.1
- VISCOSITY (centipoises): 0.6 @ 17°C
- SURFACE TENSION (dynes/cm): 28.5 @ 20°C
- MELTING POINT (°C): -95
- BOILING POINT (°C): 110.6
- FLASH POINT (°C): 4.4
- IGNITION TEMP. (°C): 480
- VAPOR PRESSURE (mm Hg): 28.4 @ 25°C
- FLAMMABILITY LIMITS: 1.2 - 7.1 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 470 @ 25°C
- PERSISTENCE (0 to 2 rating): 0

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: TRICHLOROETHYLENE
- CAS NO.: 79-01-6
- SYNONYMS: Ethylene trichloride, trichloroethene
- MOLECULAR FORMULA: C_2HCl_3
- STRUCTURAL FORMULA:

$Cl_2C = CHCl$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.466
- VAPOR DENSITY (air=1): 4.53
- VISCOSITY (centipoises): 0.566 @ 20°C
- SURFACE TENSION (dynes/cm): 29.5 @ 20°C
- MELTING POINT (°C): -73
- BOILING POINT (°C): 87.2
- FLASH POINT (°C): 32
  ignites with difficulty
- IGNITION TEMP. (°C): 410
- VAPOR PRESSURE (mm Hg): 100 @ 31.4°C
- FLAMMABILITY LIMITS: 12.5-90 (vol. % in air)
- SOLUBILITY IN WATER (ppm): 1000 @ 25°C
- PERSISTENCE (0 to 2 rating): 2

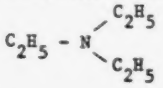
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 1 FLAMMABILITY: 1 REACTIVITY: 0
- DOT HAZARD CLASS: ORM

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: TRIETHYLAMINE
- CAS NO.: 121448
- SYNONYMS:
- MOLECULAR FORMULA: $C_6H_{15}N$
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.8
- VAPOR DENSITY (air=1): 3.5
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm): 17.3 @ -4°C
- MELTING POINT (°C): -115
- BOILING POINT (°C): 90
- FLASH POINT (°C): -7
- IGNITION TEMP. (°C):
- VAPOR PRESSURE (mm Hg):
- FLAMMABILITY LIMITS: 1.2 - 8.0 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 55,000 @ 20°C
- PERSISTENCE (0 to 2 rating):

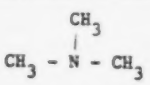
HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: TRIMETHYLAMINE
- CAS NO.: 75503
- SYNONYMS: TMA
- MOLECULAR FORMULA: C_3H_9N
- STRUCTURAL FORMULA:



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.7
- VAPOR DENSITY (air=1): 2.0
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): -117.2
- BOILING POINT (^{o}C): 2.9
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C): 190
- VAPOR PRESSURE (mm Hg): 687 @ $0^{o}C$
- FLAMMABILITY LIMITS: 2.0 - 11.6 (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 475,000 @ $30^{o}C$
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 4 REACTIVITY: 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: VINYL ACETATE
- CAS NO.: 108054
- SYNONYMS: Acetic acid ethylene ether
- MOLECULAR FORMULA: $C_4H_6O_2$
- STRUCTURAL FORMULA:

$$CH_3 - \overset{O}{\overset{\|}{C}} - O - CH = CH_2$$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.9
- VAPOR DENSITY (air=1): 3.0
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm): 23.9 @ 20°C
- MELTING POINT (°C): -92.8
- BOILING POINT (°C): 73
- FLASH POINT (°C): -8
- IGNITION TEMP. (°C): 426.7
- VAPOR PRESSURE (mm Hg): 107.5 @ 25°C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 20,000 @ 25°C
- PERSISTENCE (0 to 2 rating): 1

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 2
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: VINYLIDENE CHLORIDE
- CAS NO.: 75-35-4
- SYNONYMS: 1,1-Dichloroethylene, 1,1-dichloroethene
- MOLECULAR FORMULA: $C_2H_2Cl_2$
- STRUCTURAL FORMULA: $CH_2 = CCl_2$

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 1.25
- VAPOR DENSITY (air=1): 3.34
- VISCOSITY (centipoises): -
- SURFACE TENSION (dynes/cm): -
- MELTING POINT (^{o}C): -122.5
- BOILING POINT (^{o}C): 31.9
- FLASH POINT (^{o}C): -10 (open cup)
- IGNITION TEMP. (^{o}C): 458
- VAPOR PRESSURE (mm Hg): 500 @ 20^{o}C
- FLAMMABILITY LIMITS: 5.6-11.4 (vol. % in air)
- SOLUBILITY IN WATER (ppm): V. sl. sol.
- PERSISTENCE (0 to 2 rating): -

HAZARD CLASSIFICATIONS

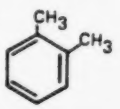
- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: 2 FLAMMABILITY: 4 REACTIVITY: 2
- DOT HAZARD CLASS: -

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: XYLENE
- CAS NO.: 1330207 (mixed); 108383 (m-); 95476 (o-); 106423 (p-)
- SYNONYMS: Dimethylbenzene; Xylol
- MOLECULAR FORMULA: C_8H_{10}
- STRUCTURAL FORMULA:

(ortho)



PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 0.86 - 0.88
- VAPOR DENSITY (air=1): 3.7 (o-, m-, p-)
- VISCOSITY (centipoises): 0.62 @ 20°C
- SURFACE TENSION (dynes/cm): 28.9 @ 20°C
- MELTING POINT (°C): -25 (o-); -47 (m-); 13 (p-)
- BOILING POINT (°C): 144 (o-); 139 (m-); 130 (p-)
- FLASH POINT (°C): 32.2 (o-); 28.9 (m-); 27.2 (p-)
- IGNITION TEMP. (°C): 465 (o-); 530 (m-); 530 (p-)
- VAPOR PRESSURE (mm Hg):
- FLAMMABILITY LIMITS: 1.1 - 7 (m-, p-) (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 175 @ 25°C
- PERSISTENCE (0 to 2 rating): 0

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: C
- NFPA HAZARD RATING: **HEALTH:** 2 **FLAMMABILITY:** 3 **REACTIVITY:** 0
- DOT HAZARD CLASS: F.L.

HAZARDOUS SUBSTANCES DATA SHEET

IDENTIFICATION

- NAME: ZINC CHLORIDE (solid, often shipped in solution)
- CAS NO.: 7646857
- SYNONYMS: Butter of zinc
- MOLECULAR FORMULA: Cl_2Zn
- STRUCTURAL FORMULA:

PHYSICAL/CHEMICAL PROPERTIES

- SPECIFIC GRAVITY (water=1): 2.97
- VAPOR DENSITY (air=1):
- VISCOSITY (centipoises):
- SURFACE TENSION (dynes/cm):
- MELTING POINT (^{o}C): 290
- BOILING POINT (^{o}C): 732
- FLASH POINT (^{o}C):
- IGNITION TEMP. (^{o}C):
- VAPOR PRESSURE (mm Hg): 100 @ 610^{o}C
- FLAMMABILITY LIMITS: (Vol. % in air)
- SOLUBILITY IN WATER (ppm): 4,320,000 @ 25^{o}C
- PERSISTENCE (0 to 2 rating):

HAZARD CLASSIFICATIONS

- EPA REPORTABLE QUANTITY CATEGORY: D
- NFPA HAZARD RATING: HEALTH: FLAMMABILITY: REACTIVITY:
- DOT HAZARD CLASS:

APPENDIX C

SORBENT MATERIAL DATA SHEETS

IDENTIFICATION

- BRAND OR COMMON NAME: **Absorbent 1012**
- CHEMICAL NAME OR DESCRIPTION: **expanded volcanic rock, treated to repel water**
- MOLECULAR FORMULA:
- FORM: **granules, packed in 25 lb. bags**

PROCUREMENT

- MANUFACTURER/PROCESSOR: **Colloid Chemicals Co., P.O. Box 861, Brockton, MA 02403**
- MATERIAL COST ($/LB): 0.33 (a)

PROPERTIES

- DENSITY (LBS/FT^3): 6.5 (a) ; (g/cm^3): 0.1
- DEGRADABILITY: none
- FLAMMABILITY: none
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB): 5-7 (b)
- RETENTION CAPACITY: good (b)
- AFFINITY FOR WATER: low (b)

REFERENCES

(a) Robertson, 1978
(b) Arthur D. Little, 1974

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: ash
- CHEMICAL NAME OR DESCRIPTION: inert residue of coal combustion
- MOLECULAR FORMULA:
- FORM: powder

PROCUREMENT

- MANUFACTURER/PROCESSOR: many throughout the U.S.
- MATERIAL COST ($/LB): 0.01

PROPERTIES

- DENSITY (LBS/FT^3): ; (g/cm^3):
- DEGRADABILITY: none
- FLAMMABILITY: none
- TOXICITY:
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER:

REFERENCES

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: calcium carbonate, limestone
- CHEMICAL NAME OR DESCRIPTION: calcium carbonate
- MOLECULAR FORMULA: $Ca\ CO_3$
- FORM: powder

PROCUREMENT

- MANUFACTURER/PROCESSOR: many throughout the U.S.
- MATERIAL COST ($/LB): 0.01-0.02 (a)

PROPERTIES

- DENSITY (LBS/FT^3): ; (g/cm^3):
- DEGRADABILITY: none
- FLAMMABILITY: none
- TOXICITY:
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER:

REFERENCES

(a) Bauer et al., 1975

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: cellulose, vegetable fiber (e.g., straw, sawdust, bark, peanut hulls, corn cobs, peat moss)
- CHEMICAL NAME OR DESCRIPTION: cellulose
- MOLECULAR FORMULA:
- FORM: strands, powder, chips

PROCUREMENT

- MANUFACTURER/PROCESSOR: many throughout the U.S.
- MATERIAL COST ($/LB): (straw) .01-.02 (a)

PROPERTIES

- DENSITY (LBS/FT^3): (straw) 62 (a) ; (g/cm^3): 0.99
- DEGRADABILITY: high
- FLAMMABILITY: very high
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER: variable

REFERENCES

(a) Robertson, 1978

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Conwed
- CHEMICAL NAME OR DESCRIPTION: cellulose fiber treated to repel water
- MOLECULAR FORMULA:
- FORM: sheets, pads, sweeps, strips, pillows, rugs

PROCUREMENT

- MANUFACTURER/PROCESSOR: Conwed Corp., 332 Minnesota St., St. Paul, MN 55101
- MATERIAL COST ($/LB): 1.36-4.40 (a)

PROPERTIES

- DENSITY (LBS/FT^3): 3.2 (b) ; (g/cm^3): 0.05
- DEGRADABILITY: biodegradable, sensitive to UV (b)
- FLAMMABILITY: high
- TOXICITY:
- SORPTION CAPACITY (LBS/LB): benzene: 12.6 (d); phosphoric acid (85%): 5 (c)
- RETENTION CAPACITY:
- AFFINITY FOR WATER: low

REFERENCES

(a) Swanson, 1978
(b) Robertson, 1978
(c) Diamond Shamrock Corp.
(d) Bauer et al., 1975

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Conwed-D
- CHEMICAL NAME OR DESCRIPTION: closed-cell polyethylene foam, mechanically modified to increase sorption
- MOLECULAR FORMULA: $-[CH_2-CH_2-]_n$
- FORM: pads, 21 x 21 x 1/4"

PROCUREMENT

- MANUFACTURER/PROCESSOR: Conwed Corp., 332 Minnesota St., St. Paul, MN 55101
- MATERIAL COST ($/LB): 3.59 (a)

PROPERTIES

- DENSITY (LBS/FT^3): 2.3 (b) ; (g/cm^3): 0.04
- DEGRADABILITY: none
- FLAMMABILITY: low
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER: very low

REFERENCES

(a) Swanson, 1978
(b) Robertson, 1978

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Diasorb, Universal Sorbent Material (USM)
- CHEMICAL NAME OR DESCRIPTION: silicate glass foam
- MOLECULAR FORMULA: SiO_2
- FORM: granules, 8-200 mesh

PROCUREMENT

- MANUFACTURER/PROCESSOR: Diamond Shamrock Corp., Soda Products Division, 1100 Superior Ave., Cleveland, OH 44114
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): 2.2 (a) ; (g/cm^3): 0.04
- DEGRADABILITY: none
- FLAMMABILITY: none
- TOXICITY: LC_{50}(inhalation) >2.32 mg/ℓ (b); LD_{50} (oral) >15,380 mg/kg (b)
- SORPTION CAPACITY (LBS/LB): (b) acrylonitrile: 10.2; benzene: 10.6; formaldehyde (37%): 8.6; nitric acid (70%): 20; phenol (83%): 15.5; phosphonic acid (85%): 28; sulfuric acid (96%): 19.2; toluene/xylene: 11.2
- AFFINITY FOR WATER: fair

REFERENCES

(a) Diamond Shamrock Corp..1976.
(b) Temple et al., 1978

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Fiberperl
- CHEMICAL NAME OR DESCRIPTION: mixture of expanded perlite and cellulose fiber, treated to repel water
- MOLECULAR FORMULA:
- FORM: particles packed in 18-lb. bags

PROCUREMENT

- MANUFACTURER/PROCESSOR: Grefco Inc., 630 Shatto Place, Los Angeles, CA 90005
- MATERIAL COST ($/LB): 0.31 (a)

PROPERTIES

- DENSITY (LBS/FT^3): 4.5 (a) ; (g/cm^3): 0.07
- DEGRADABILITY: low
- FLAMMABILITY: high
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB): perchloroethylene: 8 (b); phosphoric acid (85%): very poor (b)
- RETENTION CAPACITY:
- AFFINITY FOR WATER: very low

REFERENCES

(a) Grefco, Inc.
(b) Diamond Shamrock Corp., 1979.

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Graboil
- CHEMICAL NAME OR DESCRIPTION: polyurethane foam treated to repel water
- MOLECULAR FORMULA: $-\left[OROCNHR'NHC\right]_n-$ (O and O above the C atoms)
- FORM: sheets, batts, booms

PROCUREMENT

- MANUFACTURER/PROCESSOR: RBH Cybernetics, Ltd., P.O. Box 4205, Postal Station A Victoria, B.C., Canada
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): 1.2 (a) ; (g/cm^3): 0.02
- DEGRADABILITY: none
- FLAMMABILITY: fair, generates hydrogen cyanide upon combustion
- TOXICITY:
- SORPTION CAPACITY (LBS/LB): 20 (b)
- RETENTION CAPACITY:
- AFFINITY FOR WATER: low

REFERENCES

(a) Robertson, 1978
(b) Arthur D. Little, 1974

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Ground Rubber
- CHEMICAL NAME OR DESCRIPTION: ground cured scrap rubber
- MOLECULAR FORMULA:
- FORM: particles

PROCUREMENT

- MANUFACTURER/PROCESSOR: Rubbermaid Co.
- MATERIAL COST ($/LB): 0.15 (a)

PROPERTIES

- DENSITY (LBS/FT^3): ; (g/cm^3):
- DEGRADABILITY: low
- FLAMMABILITY: high
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER: very low

REFERENCES

(a) Robertson, 1978

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Imbiber Beads
- CHEMICAL NAME OR DESCRIPTION: cross-linked allylstyrene and tertiary butyl copolymers (a)
- MOLECULAR FORMULA:
- FORM: granules packed in polyolefin fiber bags

PROCUREMENT

- MANUFACTURER/PROCESSOR: Dow Chemical Co., 2030 Dow Center, Midland, MI 48460
- MATERIAL COST ($/LB): 2.65 (b)

PROPERTIES

- DENSITY (LBS/FT^3): 61.3 (b); 40 (c) ; (g/cm^3): 0.98 (b); 0.64 (c)
- DEGRADABILITY: very low
- FLAMMABILITY:
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB): up to 27 (c)
- RETENTION CAPACITY: very high (a)
- AFFINITY FOR WATER: very low (a)

REFERENCES

(a) Akers et al., 1978
(b) Robertson, 1978
(c) Arthur D. Little, 1974

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: 3M Oil Sorbent
- CHEMICAL NAME OR DESCRIPTION: polypropylene (b) or polyethylene (c) fiber
- MOLECULAR FORMULA: $-[CHCH_3CH_2-]_n$

  $-[CH_2CH_2-]_n$
- FORM: sheets, pads, pillows, rolls, sweeps, booms, granules

PROCUREMENT

- MANUFACTURER/PROCESSOR: 3M Company, 3M Center, St. Paul, MN 55101
- MATERIAL COST ($/LB): 2.30-4.40 (a)

PROPERTIES

- DENSITY (LBS/FT^3): 3-4 (c) ; (g/cm^3): 0.05-0.06
- DEGRADABILITY: none
- FLAMMABILITY: fair
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB): benzene: 10.0 (b); chloroform: 17.8 (b)
- RETENTION CAPACITY:
- AFFINITY FOR WATER: very low (b)

REFERENCES

(a) 3M Company, 1978
(b) Akers et al., 1978
(c) Robertson, 1978

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Multipurpose Gelling Agent (MGA) (30% Imbiber Beads, 30% Hycar 1422, 25% Carbopol 934, 5% Gelgard M, 10% Cabosil)
- CHEMICAL NAME OR DESCRIPTION:
- MOLECULAR FORMULA:
- FORM: powder

PROCUREMENT

- MANUFACTURER/PROCESSOR: Calspan Corporation, Buffalo, NY 14221
- MATERIAL COST ($/LB): 2.50 (a)

PROPERTIES

- DENSITY (LBS/FT^3): ; (g/cm^3):
- DEGRADABILITY: sensitive to moisture
- FLAMMABILITY:
- TOXICITY:
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER:

REFERENCES

(a) Pilie et al., 1975

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Oil-Dri
- CHEMICAL NAME OR DESCRIPTION: crushed calcined montmorillonite clay
- MOLECULAR FORMULA: $Al_2Si_4O_{10}(OH)_2 \cdot xH_2O$
- FORM: granules, powder

PROCUREMENT

- MANUFACTURER/PROCESSOR: Oil-Dri Manufacturing Co., 520 N. Michigan Ave., Chicago, IL
- MATERIAL COST ($/LB): 0.35

PROPERTIES

- DENSITY (LBS/FT^3): 30-35 ; (g/cm^3): 0.48-0.56
- DEGRADABILITY: none
- FLAMMABILITY: none
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB): acrylonitrile: 0.7; benzene: 0.7; formaldehyde (37%): 0.7; nitric acid (70%): 2.2, phenol (83%): 1.2; phosphoric acid (85%): 2.0 sulfuric acid (96%): 1.7 toluene/xylene: 0.8
- AFFINITY FOR WATER:

REFERENCES

(a) Temple et al., 1978

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Oil Mop
- CHEMICAL NAME OR DESCRIPTION: polypropylene fiber
- MOLECULAR FORMULA: $-[CHCH_3CH_2-]_n$
- FORM: mops, rope

PROCUREMENT

- MANUFACTURER/PROCESSOR: Oil Mop, Inc., P.O. Box P, Belle Chasse, LA 70037
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): 38-57 (a) ; (g/cm^3): 0.6-0.9
- DEGRADABILITY: none
- FLAMMABILITY: fair
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER: very low

REFERENCES

(a) Arthur D. Little, 1974

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Oil Snare
- CHEMICAL NAME OR DESCRIPTION: polypropylene
- MOLECULAR FORMULA: $-[CHCH_3CH_2-]_n$
- FORM: strands

PROCUREMENT

- MANUFACTURER/PROCESSOR: Parker Systems, Inc., P.O. Box 1652, Norfolk, VA 23501
- MATERIAL COST ($/LB): 2.50

PROPERTIES

- DENSITY (LBS/FT^3): 9 (a); 3.2 (b) ; (g/cm^3): 0.14 (a); 0.05 (b)
- DEGRADABILITY: none
- FLAMMABILITY: fair
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER: very low

REFERENCES

(a) Robertson, 1978
(b) Arthur D. Little, 1974

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: perlite
- CHEMICAL NAME OR DESCRIPTION: silica - volcanic rock, crushed and heated to increase polarity and frequently treated with a silicone to repel water
- MOLECULAR FORMULA: SiO_2
- FORM: granules

PROCUREMENT

- MANUFACTURER/PROCESSOR: Grefco, Inc., 630 Shatto Place, Los Angeles, CA 90005
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): ; (g/cm^3):
- DEGRADABILITY: none
- FLAMMABILITY: none
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER: low

REFERENCES

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Petro-Trap
- CHEMICAL NAME OR DESCRIPTION: polyurethane
- MOLECULAR FORMULA: $-\left[\mathrm{OROCNHR'NHC}\right]_n-$ (O and O above the C's)
- FORM: pads enclosed in fiberglass membrane

PROCUREMENT

- MANUFACTURER/PROCESSOR: Best Textile Co., P.O. Box 157, Westport, MA
- MATERIAL COST ($/LB): 7.00-12.50/4 ft. section

PROPERTIES

- DENSITY (LBS/FT^3): ; (g/cm^3):
- DEGRADABILITY:
- FLAMMABILITY:
- TOXICITY:
- SORPTION CAPACITY (LBS/LB): benzene: 18.8 (a)
- RETENTION CAPACITY:
- AFFINITY FOR WATER:

REFERENCES

(a) Bauer et al., 1975

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: polypropylene
- CHEMICAL NAME OR DESCRIPTION: polypropylene
- MOLECULAR FORMULA: $-[CHCH_3CH_2-]_n$
- FORM: sheets, strands, powder

PROCUREMENT

- MANUFACTURER/PROCESSOR: Dow Chemical Co.
  2030 Dow Center
  Midland, MI 48460

  Phillips Petroleum Co., Plastics Div.
  P.O. Box 792
  Pasadena, TX 77501
- MATERIAL COST ($/LB): 0.24 - 0.29

PROPERTIES

- DENSITY (LBS/FT^3): ; (g/cm^3):
- DEGRADABILITY: less resistant to chemical attack than cross-linked polymers such as polyurethane
- FLAMMABILITY: fair
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER: very poor

REFERENCES

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: polyurethane
- CHEMICAL NAME OR DESCRIPTION: polyurethane
- MOLECULAR FORMULA: $\left[OROCNHR'NHC\right]_n$ (O above C)
- FORM: all forms, in open-celled, closed-cell, and non-porous structure

PROCUREMENT

- MANUFACTURER/PROCESSOR: BASF Wyandotte Corp.
  Industrial Chemicals Group
  Wyandotte, MI 48192

  B.F. Goodrich Chemical Co.
  6100 Oak Tree Blvd.
  Cleveland, OH 44131
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): variable ; (g/cm^3):
- DEGRADABILITY: none
- FLAMMABILITY: fair, generates HCN upon combustion
- TOXICITY:
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER: low

REFERENCES

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Quik-Wick
- CHEMICAL NAME OR DESCRIPTION: polypropylene fiber, treated
- MOLECULAR FORMULA: $-[CHCH_3CH_2-]_n$
- FORM: mats, pillows, rolls

PROCUREMENT

- MANUFACTURER/PROCESSOR: Clark-Cutler-McDermott Co., 1 Fisher St., Franklin, MA 02038
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): 2.8 (a) ; (g/cm^3): 0.04
- DEGRADABILITY: none
- FLAMMABILITY: fair
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER: very low

REFERENCES

(a) Robertson, 1978

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: SAFESTEP
- CHEMICAL NAME OR DESCRIPTION: mixture of volcanic ash and perlite
- MOLECULAR FORMULA:
- FORM: powder, Size No. 1 - no more than 10.6% by weight retained by a 325 mesh screen
  Size No. 2 - no more than 10% by weight plus 3% by weight of binding agents retained by a -100 +200 mesh screen

PROCUREMENT

- MANUFACTURER/PROCESSOR: Andesite of California, Inc.
  PO Box 37157
  Los Angeles, California 90037
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): 137-150 ; (g/cm^3):
- DEGRADABILITY: none
- FLAMMABILITY: non-flammable
- TOXICITY: non-toxic
- SORPTION CAPACITY (LBS/LB): 5
- RETENTION CAPACITY: very high
- AFFINITY FOR WATER: 0.297 g/g

REFERENCES

Andesite of California, Inc., 1980

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: SSC Absorbent DS, SP, SS, ST
- CHEMICAL NAME OR DESCRIPTION: treated polyurethane
- MOLECULAR FORMULA: $-\left[\mathrm{ROCNHR'NHC}\right]_n-$ (O and O)
- FORM: disposable sorbent granules (DS), sorbent pillows (SP), sorbent sheets (SS), sorbent towels (ST)

PROCUREMENT

- MANUFACTURER/PROCESSOR: Sorbent Sciences Corp.. 1269 East Edna Place, Covina, CA 91724
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): 1.7 (b) ; (g/cm^3): 0.27
- DEGRADABILITY: very low
- FLAMMABILITY: fair, generates HCN on combustion
- TOXICITY:
- SORPTION CAPACITY (LBS/LB): 40-60 (b)
- RETENTION CAPACITY:
- AFFINITY FOR WATER: low (a)

REFERENCES

(a) Akers et al., 1978
(b) Arthur D. Little, 1974

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Slikwik
- CHEMICAL NAME OR DESCRIPTION: cellulose-ground corn cobs
- MOLECULAR FORMULA:
- FORM: particles packed in 37-lb. polyethylene bags

PROCUREMENT

- MANUFACTURER/PROCESSOR: Slickbar, Inc., P.O. Box 139, Southport, CT 06490
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): 8.8 (a) ; (g/cm^3): 0.14
- DEGRADABILITY: high
- FLAMMABILITY: high
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER:

REFERENCES

(a) Robertson, 1978

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Sorbent C
- CHEMICAL NAME OR DESCRIPTION: mixture of expanded perlite and cellulose fiber, treated to repel water
- MOLECULAR FORMULA:
- FORM: fluffy particles

PROCUREMENT

- MANUFACTURER/PROCESSOR: Clean Water Inc., P.O. Box 1002, Toms River, NJ 08753
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): 4.5 (a) ; (g/cm^3): 0.07
- DEGRADABILITY: low (b)
- FLAMMABILITY: high
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB): 8-10 (b)
- RETENTION CAPACITY: high (b)
- AFFINITY FOR WATER: very low (b)

REFERENCES

(a) Robertson, 1978
(b) Arthur D. Little, 1974

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Sorb-Oil
- CHEMICAL NAME OR DESCRIPTION: recycled fiberboard
- MOLECULAR FORMULA:
- FORM: mats, chips, swabs, booms

PROCUREMENT

- MANUFACTURER/PROCESSOR: Innova Corp., 444 NE Ravenna Blvd., Seattle, WA 98115
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): ; (g/cm^3):
- DEGRADABILITY: high
- FLAMMABILITY: very high
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER: high

REFERENCES

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Spill Control PEP
- CHEMICAL NAME OR DESCRIPTION: polyurethane foam
- MOLECULAR FORMULA: $+OROCNHR'NHC\overset{O}{\overset{\|}{}}\overset{O}{\overset{\|}{}}+_n$
- FORM: sheets, pads, pillows, strips, booms

PROCUREMENT

- MANUFACTURER/PROCESSOR: Spill Control Co., 828 North Grand Ave., Covina, CA 91724
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): ; (g/cm^3):
- DEGRADABILITY: none
- FLAMMABILITY: fair, generates HCN on combustion
- TOXICITY:
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER:

REFERENCES

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: vermiculite
- CHEMICAL NAME OR DESCRIPTION: clay mineral, crushed and heated to increase porosity and treated to improve sorption
- MOLECULAR FORMULA: $Mg_3Si_4O_{10}(OH)_2 \cdot x\ H_2O$
- FORM: granules packed in bags

PROCUREMENT

- MANUFACTURER/PROCESSOR:
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): 4.5 (b) ; (g/cm^3): 0.07
- DEGRADABILITY: none
- FLAMMABILITY: none
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB): perchloroethylene: 3.5 (a); phosphoric acid (85%): 6.5 (a)
- RETENTION CAPACITY:
- AFFINITY FOR WATER:

REFERENCES

(a) Diamond Shamrock Corp., 1979.
(b) Robertson, 1978

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Winkler Foam
- CHEMICAL NAME OR DESCRIPTION: mixture of polystyrene beads and polyurethane chips or rubber fibers
- MOLECULAR FORMULA:
- FORM: mixture of beads and chips or fibers

PROCUREMENT

- MANUFACTURER/PROCESSOR:
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): 1.5 (a) ; (g/cm^3): 0.02
- DEGRADABILITY: none
- FLAMMABILITY: fair
- TOXICITY:
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER: very low

REFERENCES

(a) Robertson, 1978

SORBENT MATERIAL DATA SHEET

IDENTIFICATION

- BRAND OR COMMON NAME: Zorbite
- CHEMICAL NAME OR DESCRIPTION: expanded and treated silicate glass
- MOLECULAR FORMULA:
- FORM: granules

PROCUREMENT

- MANUFACTURER/PROCESSOR: Spill Control Co., 828 North Grand Ave., Covina, CA 91724
- MATERIAL COST ($/LB):

PROPERTIES

- DENSITY (LBS/FT^3): 9 (a) ; (g/cm^3): 0.14
- DEGRADABILITY: none
- FLAMMABILITY: none
- TOXICITY: none
- SORPTION CAPACITY (LBS/LB):
- RETENTION CAPACITY:
- AFFINITY FOR WATER:

REFERENCES

(a) Robertson, 1978